Staff Report for 2025 State Board of Equalization

File No.: 2025-RANSOM-DOPP **Prepared By:** Property Tax Division

County or City: RANSOM COUNTY

Appellant: MS. SUSAN DOPP

Type of Appeal: RESIDENTIAL VALUE

Appeal Issue: Ms. Susan Dopp is appealing the property value of $375,600 on parcel number 13-3996000, located at 13291 55th Street SE, Enderlin, ND.

Analysis:

Summary of Findings:

Proposal for Board Review:

Document A

Appellant Information – State Board of Equalization

County or City: Ransom County
Appellant: Susan Dopp
Type of Appeal: Residential

Please complete this form in its entirety. The information provided will be taken into consideration when investigating and reaching a conclusion regarding the appeal presented. To provide ample time for investigation, all information to support the appeal (property information, pictures, income information, etc.) must be received by August 1, 2025, and is subject to open records. Please provide one questionnaire per property.

Please email or mail any supporting documentation to:
propertytax@nd.gov
or
The Office of State Tax Commissioner, Attn: Property Tax,
600 E Boulevard Ave., Bismarck, ND 58505-0599

Information for Property Referenced in Appeal:

Address: 13291 55th ST SE, Enderlin ND 58027.9765
Township Name: Liberty
County: Ransom County
Parcel ID: 013-13-3996000
Legal Description: SECT-06 TWP-136 RANG-055 SE1/4-6-136-55

Appellant Contact Information:

Appellant Name: Susan Dopp
Address: 13291 55th ST SE, Enderlin ND 58027.9765
Phone Number: 701.437.3259
Email Address: doppsusan@hotmail.com

Answer the questions below that apply to the appeal:

Are you the owner of the property of this appeal? ☒ Yes ☐ No

Did you receive a notice of increase letter from the city/township? (choose all that apply)
☒ Prior to ☐ After Township/City Equalization Meeting
☒ Prior to ☐ After County Equalization Meeting
☐ No Notification Received

At which meeting(s) did you appeal your assessment? (choose all that apply)
☒ Township/City ☒ County ☐ N/A

Please note NDCC § 57-13-04.3(a)(1)(2) requires appellants to appeal to the State Board of Equalization must have applied to both local and county boards.

Has a recent appraisal been completed on the property?

☐ Yes (if yes, please attach) ☒ No

What grounds is your appeal based upon? Please check all that apply and provide supporting documentation for each selection.

☐ Factual error, that is, a data collection or clerical error.

☐ Equity and uniformity claim of discriminatory level of assessment.

☒ Belief that the valuation is inaccurate.

☒ Exemption, classification, or assessment limitation.

Please attach or email (propertytax@nd.gov) the following:

1. A detailed explanation of your appeal
2. Evidence to validate the assessment appealed

Appeal Process:

1.) Appellant notifies the Property Tax Division of intent to appeal.

2.) Submit this form and all applicable documentation to propertytax@nd.gov by the date specified above.

3.) The State Board of Equalization meets on the second Tuesday in August to examine and compare the returns of the assessment of taxable property as submitted by North Dakota counties. This is locally assessed property. The board equalizes the property so that all assessments of similar taxable property are uniform and equal throughout the state. During this meeting, tax directors or other representatives from a county will speak, along with city representatives, and individual taxpayers.

4.) After the State Board meeting, your case will be assigned, and staff will reach out to schedule an onsite review of the property (when deemed applicable). While an interior inspection of the property is not required, interior reviews may affect the consideration of value. If denied an interior review, we will assess from the exterior only. Staff will not be allowed to enter the property without the owner or a representative present.

5.) Generally, by the first Thursday of October, the property tax division staff will present their findings to the State Board of Equalization with a recommendation. The board deliberates and votes. You can attend this meeting; however, public comments are not accepted.

Dear ND Tax Office employee: After attending the appropriate township meeting and the county commission meetings, I wish to file an appeal for Liberty Township, Ransom County, North Dakota real estate "Parcel Number 13-3996000" . I herewith request a questionnaire, the succinct list of other evidence to be submitted, and other pertinent data required by this process.

Following a review of the pdf entitled "ND Tax Property Tax Assessment Process" (retrieved from [When I copy and paste the link from the ND Tax website this is what appears, i.e. it is NOT an error on my part White and Gray Clean and Corporate Energy Flyer]), I request the following information and have the following questions at this time; thank you, in advance, for your responses.

1. I herewith request the applicable North Dakota Century Code (hereafter NDCC) that changed during the 2025 North Dakota legislative session and their effective implementation dates.

2. Are the State Board of Equalization meeting minutes for March 2025 and July 2025 (Draft Only is probably available at this time) available at another digital location because they are more recent? Here is where I searched for them: State Board of Equalization | North Dakota Office of State Tax Commissioner

3. Are there any 2025 North Dakota legislative changes that would impact the content of the pdf "ND Tax Property Tax Assessment Process" and may not have been changed yet?

4. I herewith a request a succinct list in lay person's language of any and all actions and requirement for the process of paying property taxes under protest. I find NDCC 57-20-20 rather slim on operational details, and NDCC 57-23 refers to the Application for Abatement or Refund of Taxes (SF24775, 2-2016 was the most recent one I could find) which begins with the statement, "File with the County Auditor on or before November 1 of the year following the year in which the tax becomes delinquent." My husband and I intend to pay the "tax under protest" thereby avoiding the discussion of "delinquent taxes," unless the issue becomes moot following the actions of the ND State Board of Equalization.

5. Please share any additional information important to the functions and processes of the August 12, 2025 meeting that I need to know, should know, and

because of having no prior experience with this North Dakota learning opportunity am not aware of. Thanks!

4.

Feel free to contact me by email or by calling 701.437.3259 for clarification of any of this email's content. Thank you for your attention to these requests.

Regards,

Susan Dopp, 13291 55th ST SE, Enderlin ND 58027

Susan M. Dopp
13291 55th Street Southeast
Enderlin ND 58027
doppsusan@hotmail.com

Contents includes requested information for appeal of Real Estate Assessment on Ransom County ND Parcel 13-3996000

For additional information and knowledge, kindly contact me through one of the means listed above.

S. M. Dopp
7.30.2025

In response to my request to appeal the information received March 28, 2025, on SFN 24743 "Notice of Increase in Real Estate Assessment" to the North Dakota (ND) State Board of Equalization (SBOE) ollowing appeals at the township and county levels, I was directed by Ms. Hasenyager, Administrative Assistant, Property Tax Division, ND Office of State Tax Commissioner to submit the following:

Section I. A completed Appellant Questionnaire is attached to this email and also included in the document collection,

Section II. Requested information: "A Detailed Explanation of Your Appeal," and

Section III. Requested information: "Evidence Deemed Necessary to Validate the Appeal of Assessment"

I herewith submit the content required to fulfill this information request.

Section I. A completed Appellant Questionnaire is attached to this email (electronic form) and also included in the document collection (print form) Document A.

Section II. Requested information: "A Detailed Explanation of Your Appeal"

This detailed explanation of my appeal is comprised of four segments:

A. Overview, Framework, and Context of Appeal

B. The agricultural land we have developed in the past 30 years and farm building functions (data and subsequent valuation on most recent "Property Card" continues to contain inaccuracies).

C. Seeking exemptions of all outbuilding assessments and re-assessment of 65-year-old house based on Item B above.

D. Conclusion

First, a general overview of events. Please note that supporting evidence and documentation is provided in parentheses and labeled with a letter. On March 28, 2025, my husband, Michael J. Martin, and I received the mailing "Notice of Increase in Real Estate Assessment" (Document B) stating the true and full value of Parcel 13-3996000 (160 acres including farm buildings and a house) had increased 33.8% from 299,400 to 400,600. While an increase in the true and full value was not unexpected, the rate of the increase was. My husband had concerns and had expressed them in writing three months prior to the 3.28.25 mailing (Document C). In addition, 3 individuals from the Ransom County Tax Director's office conducted an inspection on May 29, 2024 and the resulting Property Card (Document D) had been emailed on December 9, 2024.

From conversation with the inspection crew on May 29, 2024 onward, the issue of functionalism has been one of my expressed concerns due to the aging of the buildings, the challenges we face with water

productivity of grasslands" (p. 2). If you prefer a webliography of Dr. Manske's work, please email a request to me.

In a nutshell, Manske's research supports the concept there is more to land values than the soil types, and there is more to vegetation than traditional crops. He identifies 4 types of Native vegetation (p. 3), 2 soil temperature and 4 soil moisture regimes (p. 3), obviously more than just soil types. With our latitude and longitude, grassland management included properly managed annually grazed grasslands (pp. 8-9). Manske describes the "twice-over rotation" strategy which we implemented on our zoned native grassland pastures, and each pasture zone is grazed for 2 periods of time per growing season (p. 10).

For decades we have been attempting to improve the grassland ecosystem on our property by planting native vegetation, zoning these planted areas and other adjoining pastureland, and using twice-over grazing rotations for the cow-calf operation. Wet areas and the creek were adequate until a neighbor tiled his cropland adjacent to our northernmost zone, thereby draining the moisture from that area, a violation Ransom County Farm Service Agency ignored when brought to their office's attention (so much for "Sodbuster and swamp buster.")

The ND Tax Department document "Guideline-Property Tax: Valuation Concepts-Agricultural Property" states on page 2, "Detailed soil surveys provide an accurate method of estimating the relative agricultural value for each parcel." The 3 steps that follow were not, to my knowledge, completed by our Ransom County Tax Director responsible for the assessment. It would seem that the modifications we have made might be included in or should be considered for inclusion in the "schedule of modifiers approved by the state supervisor of assessments to adjust for conditions not documented in the soil surveys" (p. 2). A North Dakota researcher recognized beyond the state boundaries for his lifetime of research has provided a roadmap for not only soil types but also Native vegetation, soil temperature and soil moisture regimes for OUR grasslands ecosystem.

In North Dakota, the non-growing season requires the cattle to be up in the yard with buildings to provide shelter from the elements. We find that the animals like east or southern exposure to the sunlight in cold weather; hence, some of our outbuildings open on those sides. Additionally, hay storage that preserves the nutritional value is important along with minerals and vitamins added to feed at appropriate times for pregnant cows. During calving season, cow-calf pairs need to be separated from cows. Since our livestock does better with daily water all year, we eventually put our rural water (for the house) and well water (for the livestock) control area in a heated wellhouse located in what the Ransom County Tax Director named "well house/Man Shed #2;" we call it the bunkhouse. You can see pictures of the outside on pp. 6 and 7 of Document H, the latest Property Card (dated 6.18.25) from the Ransom County Tax Director after a second inspection on June 10, 2025; the sketch is on page 11 and the total square footage in the sketch is 1325 whereas the 2nd item on the list on page 4 states 1930 square feet. The bunkhouse no longer has bunks and is no longer usable because of the humidity damage done by the wellhouse function of this building; the contents (books) are humidity-laden, to put it nicely. Supplies with animals need to be kept in different buildings away from curious animals, including Shed #3 (255 square feet) on pages 7 and 11 of Document H; as I explained at the 6.3.25 Ransom County equalization

meeting (Documents I and J are from the 2 Ransom County equalization meetings), oils, belts, fluids, and filters for farm equipment are stored here along with a lawnmower and other "farm stuff." Try to run equipment for a cow-calf operation without your own supplies on hand, especially if you need to use quipment with engines.....

Trailers and a 5 wheeler with a dumping feature (some call it a gator but this one was long before "gators"! It's more like a mini-dump truck.) are kept in the "Studio/Kennel Shed #1" shown on pages 11 and is labeled "studio/She/Shed#1" on page 6. Beginning in December 2024, I explained to the RC Tax Director this building has never been called a she shed; my explanation at the 6.3.25 Ransom County meeting explaining the bugs in this building with the garage door being open a lot of the time not being a feature most women enjoy in a she shed and the fact there is no plumbing made no impact either.

The 6.18.25 Property Card continues to say this is a gas heated house (p. 2). We replaced the fuel oil fired boiler system with a forced air fuel oil furnace in the 1990s. Also on page 2 is information identifying carpet as part of the flooring; on a rare summer day when I could no longer tolerate KNOWING the farm dirt was in the carpet, I removed 100% of the carpet and threw it out on the front steps. The Ransom County inspectors may have confused large antique rugs that wear like iron for carpet.

In summation of this second section, I have shared facts about our 30 some year grassland ecosystem development efforts with our property and provided you with the outbuilding functions and how they relate to the twice-over grazing aspects and other features of the cow-calf operation, and this included ome apparent inaccuracies from the latest Property Card.

In the third segment, the final one before the summation of this section, I wish to seek exemptions of all outbuildings and to have a re-examination of the 65-year-old house based on Item B above.

In crisp language, one cannot run a cow-calf operation with twice-over rotational grazing to develop the grassland ecosystem in North Dakota summers and winters without sufficient equipment, supplies, and buildings.

Regarding the 65-year-old house: It was built in 1960 for $17,000 turnkey, and this was when a carpenter was $1.65 per hour. The land the house was built on was, as mentioned, bought by the family in 1940. The county's most recent appraisal assessment came in at $187,800 (down from the December 2024 assessment at $195,000). That still is quite an increase. New construction for a similar home, without a lot, is $400,000 plus. Why does government exploit numbers we cannot control? Meanwhile we continue to use the 65-year-old kitchen flooring and original stovetop---it works, i.e. it is functional!

Also with regard to the rural water in the house, I do believe it is not too much too ask in 2024 and 2025 that clean, available water does not look like the Romanian Somes River floodwaters in 2005 following he cyanide spill in 2000. Our rural water is so "special" that the Calphalon cookware company has given me my third and final teapot with a "lifetime warranty," i.e. I have been through 3 lifetimes according to them.....

The Enderlin Community in 1960, when this house was built, had a thriving main street with 3 grocery stores, a resident doctor, i.e. an MD, and 3 attorneys. Now we do not have a grocery store or a practicing ttorney. A PA currently supplants an MD in Enderlin with local news indicating that clinic may soon close; the option will be a Lisbon PA who supplants an MD and a 12-minute office visit retails for $350. And this is after a 17 mile one-way trip. There was value in our property taxes when the house was built. Today, we pay much, much more and get much, much less. How is the formula where the county controls valuation within a zip code of fair?"

This context is also socially challenging . Let's frame this as social capital defined by Bob Putnam initially as trust, networks, and norms and in a personal email, stated more recently the actions of these---trusting, networking, and norming---ING being the operative change, are appearing to make the real difference in communities. How many people really want to move to a community anywhere without a grocery store or pharmacy? For the marginalized individuals in and near Enderlin, getting healthy food is a big challenge since many people do not garden indoors in the winter, and the Dollar General store is not a source for unprocessed food. Combine a food desert with the decreasing "service" level of the local post office (we frequently only get mail 5 days a week and that began in 2010----15 years ago), and you don't have people talking with others in the produce section or when they mail holiday gift packages to friends and family elsewhere. Decrease the interactions and the trusting, networking, and norming follow suit and healthy, supportive quality of life is diminished. Along with the food desert, we have a digital divide that blew up in our faces for students during Covid; it was amazing how the discussions were so similar o those during the Bill and Melinda Gates Foundation Library Public Access Computer (PAC) project in this state in the mid-1990s. The discussions also mirrored those in 2010 with Bibliotech, the Romanian version of the PAC project also funded by the Gates Foundation and administered by the International Research and Exchanges Board (IREX). We can and we must do better than Romania, don't you think?

Here's an idea for a start: Another consideration for communicating might be added to this process also. After the township meeting, we received no information in writing without asking. The RC Tax Director was the one who showed me the change sheet and provided a copy at my request. After the county meeting, I requested a digital version of the updated copy I received on 6.17.25 since changes were approved by the commissioners. In the writing of my husband months ago about this process, "Why doesn't Liberty Township and Ransom County develop a 1 page form the taxpayer uses to state in writing the disputed valuation amount, the reasons why, and suggestions for resolution? The township and county equalization boards would then show, in writing, how they voted on the request. The completed form would be given to the taxpayer so they know the official action which would help the property owner decide what to do next." In other words, the taxpayer does not have to request information for each and every step along the way. This is not an appropriate arena for discovery learning and must be very challenging for illiterate and naïve communicators and other marginalized individuals.

The consistent question I asked at the township and county levels of this process is this, and by the way, I look forward to actionable responses to it, including yours: What is your vision for this area 55 miles southwest of Fargo in rural North Dakota for 5 years, 10 years, 25 years, and 50 years from now?

In conclusion, following an overview and the identification of the framework and context of this real estate assessment appeal, an explanation of our development of the agricultural land and the outbuildings was provided. Additionally, property card challenges were identified. These factors are the reason we are seeking exemptions of all outbuilding assessments that exist currently and the re-assessment of a 65-year-old house. Support documents were identified and these documents serve as evidence deemed necessary to validate this appeal of assessment.

Thank you for the opportunity to write about this North Dakota experience. Not knowing (bit I have asked!) about your personal learning style—you, the reader; so if you have read this response in its entirety, thank you. I look forward to answering your questions on Tuesday, August 12, 2025.

Section III. Requested information: "Evidence Deemed Necessary to Validate the Appeal of Assessment"

Label Document Title

A. Appellant Information-State Board of Equalization
B. Most recent "property card" received from the Ransom County Tax Director on June 18, 2025: 13-3996000.pdf
C. Michael J. Martin (2024)Letter to ND Governor Kelly Armstrong, dated December 23, 2024.
D. 12.9.2024 Property Card for Parcel 13-3996000 received from Ransom County Tax Director
E. April 14, 2025 Proceedings of Township Board of Equalization, Liberty Township, Ransom County ND
F. May 2025 Change Sheet received from Ransom County Tax Director. Changes in True and Full Value. Assessment District: Liberty. February 1, 2024 to February 1, 2025.
G. Manske, L. (2018) in chapter "Restoring degraded grasslands" taken from Marshall, A. and Collins, R. (ed.) (2018), *Improving grassland and pasture management in temperate agriculture.* Cambridge UK: Burleigh Dodds Science Publishing. Retrieved from https://library.ndsu.edu/ir/handle/10354/28801
H. 6.18.2025 Property Card for Parcel 13-3996000 received from Ransom County Tax Director after 2nd Ransom County Board of Equalization meeting on 6.17.25
I. Ransom County Board of Commissioners Minutes. Regular Meeting. June 3, 2025
J. Ransom County Board of Commissioners Minutes. Regular Meeting. June 14, 2025 and my email to the Ransom County Auditor asking for "Also present" to include my name since I attended the 5 hour plus meeting in person. When she provides the amended version, I will forward a copy.

RANSOM COUNTY BOARD OF COMMISIONERS
Regular Meeting – June 3, 2025

The meeting was called to order by Chair Greg Schwab at 9:00am. The Pledge of Allegiance was recited. Members present: Todd Anderosn, Neil Olerud, Sye Olson, Kevin Bishop, Greg Schwab, Auditor Nicole Gentzkow, and Lynn Kaspari from the Ransom County Gazette and Grant Dick. Joining via teams: Maria Langland, Nickela Runck, Kathie Erickson, Makayla Briss, Betsy Greenly, and Janelle Maris.

Greg Schwab passed a letter around from Recorder Shelly Schwab asking for her office to be closed in the afternoon on June 5 for funerals.

Agenda was reviewed. Bishop moved with the addition of procedures, 130th Ave, and JDA, Anderson seconded the motion. All aye. Motion carried.

Minutes from the previous regular scheduled commission meeting on May 20, 2025 were reviewed. Bishop moved, seconded by Olson to approve the minutes with the correction. All aye. Motion carried.

Darla Haecherl joined the meeting via teams at 9:12am.

Manual warrants in the amount of $14,620.82 were reviewed. Bishop moved, seconded by Olson to approve the manual warrants in the amount of $14,620.82. All aye. Motion carried.

MARCO	168.25
OTTER TAIL POWER CO	59.64
THE ONSHIP GROUP, INC	200.00
LIBERTY BUSINESS SYSTEMS, INC.	278.99
OTTER TAIL POWER CO	42.71
OTTER TAIL POWER CO	499.30
SOUTHEAST WATER USERS	106.52
MARCO	153.06
LISBON, CITY OF	72.50
CASS COUNTY ELECTRIC COOP	207.12
MARCO	229.01
MARCO	10.00
MARCO	75.00
CASS COUNTY ELECTRIC COOP	47.28
CASS COUNTY ELECTRIC COOP	63.57
CASS COUNTY ELECTRIC COOP	46.45
CASS COUNTY ELECTRIC COOP	246.69
CASS COUNTY ELECTRIC COOP	898.66
MARCO	119.47
MARCO	10.00
MARCO	165.24
MARCO	10.00
MARCO	75.00

MARCO		320.26
MARCO		10.00
OTTER TAIL POWER CO		2,009.97
LISBON, CITY OF		39.50
LISBON, CITY OF		16.00
LISBON, CITY OF		195.17
LISBON, CITY OF		81.44
OTTER TAIL POWER CO		331.79
MARCO TECH- ST LOUIS		678.46
MARCO TECH- ST LOUIS		10.00
JPMORGAN CHASE BANK NA		6,956.50
OTTER TAIL POWER CO		187.27
	Total	14,620.82

Commission Audit Listing in the amount of $40,033.47 was reviewed. Bishop moved, seconded by Olerud to approve the commission audit listing with corrections. All aye. Motion carried.

Vendor Name	**Amount**
ANDERSON,TRAVIS	625.00
BARNES COUNTY CORRECTIONAL CENTER	2,000.00
BERGEMANN,HEATHER	295.00
CASS COUNTY SHERIFF'S OFFICE	56.00
COMPUTER EXPRESS	11,130.00
DAKOTA WATER SOLUTIONS	80.00
FARM & HOME PUBLISHERS, LTD	810.00
FAT MAN TRASH	220.50
FIRST MEDIC AMBULANCE	6,416.67
GORDY'S GRILL & FILL	86.63
HOPKINS, ROBERTA PO BOX 950	15.70
LEXISNEXIS MATTHEW BENDER	299.13
LISBON POSTMASTER	231.00
LISBON TRUE VALUE	20.27
MAPLE VALLEY LOCKER, INC.	1,173.63
ND ASSOC OF COUNTIES- BISMARCK	1,287.12
NDLTAP-UGPTI/NDSU	50.00
NEWMAN SIGNS	4,582.16
PYE BARKER	2,291.00
RICHLAND COUNTY CORRECTIONS	1,190.00
RIVERSIDE BUILDING CENTER	4,877.47
SARGENT COUNTY SHERIFFS DEPARTMENT	250.00
STUTSMAN COUNTY CORRECTIONAL CENTER	412.94
TANYA WIELER	1,500.00
THRIFTY WHITE PHARMACY	58.25
TYLER TECHNOLOGIES INC.	75.00
Total	40,033.47

First Medic Ambulance is having a meeting on June 20, 2025 to discuss forming an ambulance district. The board would like to add ambulance district to the 5 county meeting agenda on July 10, 2025.

Kirsten Gilbert, emergency manager appeared before the board to discuss homeland security grant funds that the county has been awarded. The funds have been awarded for keyless entry in the social service building, the old county shop, and cameras for the old county shop. Kirsten Gilbert let the board know there has been a slight increase to the keyless entry, and she will get an updated quote from Computer Express for cameras. Olerud moved, seconded by Bishop to approve the keyless entry system and cameras. All aye. Motion carried.

An electronic gaming permit was submitted along with the appropriate fee for American Legion Bullis out of Wyndmere, ND. Discussion was had. The board would like to sent back to American Legion Bullis due to this being out of county.

10:00 AM Tax Equalization

Residence at the equalization Grant Dick, Leon Pfingsten, Joe Mathern, Susan M. Dopp, Howard Rasmusson, Tyler Schlecht, Dan Spiekermeier, Kurt and Tammie Tetzlaff, Hans & Alyssa Schommer, Calvin and Lisa Soffel.

There were multiple complaints regarding the assessing in Enderlin and values being too high. Discussion was had. Haecherl let land owners know that lots were reassessed using front foot values. Parcel 26-6995000 Haecherl asked the board to not approve. Bishop moved, seconded by Olson to deny increased value based off photos and home will be reassessed when the construction is complete. Dan Spiekermeier was disputing increase on farm land. Haecherl let him know the increase was due to miscalculation of a road. The true numbers are now being reflected, and everything was assessed based on soils. Bishop moved, seconded by Anderson to table parcel 09-3921000 until Teresa Haecherl can review. All aye. Motion carried. Calvin Soffell was disputing value, he did not attend the city equalization meeting which means he can not protest at the county level. If Stoffel would like to apply for an abatement in the tax assessor's office by November 5, 2025. Howard Rasmusson disputed square footage and classification of his duplex. Bishop moved, seconded by Olerud to have Teresa Haecherl review. All aye. Motion carried. Leon Pfingsten provided documentation proving his residence is used as farm help living quarters. Documentation was in order and submitted in time, township still choose to decline it, Olerud moved, seconded by Olson to approve the exemption based off correct documentation. All aye. Motion carried. Grant Dick is disputing the assessed value on his hunting lodge in Northland township due to it not being assessable three months out of the year. Teresa Haecherl stated the increase was due to tiered acres, which was approved by the board in 2024.

Schwab would like to review the tiered acres valuations. Anderson moved, seconded by Bishop to give a 25% reduction due to no access in the winter on Grant Dicks parcel 15-4450030. Roll call vote: Anderson – no, Olerud – no, Olson – no, Bishop – yes, Schwab – no. Motion failed.

Rebecca Borland with Bell Bank arrived at 11:20am

Nathan Berseth with Bell Bank arrived at 12:20 pm

Susan Dopp disputed taxable assessed value on her property in Liberty Township parcel 13-3996000. Olerud moved, seconded by Bishop to have Teresa Haecherl go and re-evaluate the property and present to the board at the next regular scheduled commission meeting. All aye. Motin carried Olerud moved to approve changes per Haecherl with the exception of the tabled and previously excluded properties. Motion died due to lack of a second. Bishop moved, seconded by Olson to table all properties presented by Haecherl until re-evaluation is done and presented to the board at the next regular scheduled commission meeting. All aye. Motion carried.

Anderosn moved, seconded by Olson to recess the tax equalization meeting until June 17, 2025 at 9:30am due to deadlines in the tax and auditor's office. All aye. Motion carried.

Tax Directors office hours were discussed. Teresa Haecherl let the board know her office is now working four ten-hour days and rotating their day off to keep the office open. The office is closed for thirty minutes twice per week due to only one person being in the office and lunch break. Discussion was had. Olerud moved, seconded by Bishop to allow the tax office to continue working four ten-hour days through October 1, 2025 and close the office for the thirty-minute lunch hour. The board would also like for offices to ask permission in the future before they make any changes to their hours. All aye. Motion carried.

Scott Smyth with KLJ appeared before the board to discuss the road haul project for 130th Ave and the Will's Road. The City and Commission met on June 2, 2025 there didn't seem to be much interest from the City of Lisbon to partner up on the project. At this time the commission has decided to put the project on hold indefinitely at this point. Smyth also let the board know the paving near the Anslem Bridge should be complete this upcoming week. The RFP for engineering on the McRitchie bridge are due by noon on June 4, 2025. The board will need to decide who is going to be on the RFP interview board.

Adam Schultz presented a bid he received from Knife River for north of the Sheldon and HWY 58 where the shoulders are depressing. Shultz presented three options/quotes. Bishop moved, seconded by Olerud to approve the Knife River quote for site one and option one. Quote one quote: Mobilization $19,620.79, Dite 1 (75'x28') $16,571.85 for a grand total of $36,192.64. Schultz let the board know that the Elliott Road is in rough shape and he feels a new product called mastic which is rubber and rock together would be useful. The cost for the machine to

apply the mastic is $10,283.00 per month for the machine rental, and $32,736.00 per truck load of material which also includes delivery. Discussion was had.

Nathan Berseth and Rebecca Borland with Bell Bank appeared before the board to introduce themselves to the new commissioners and go over the benefits of banking with Bell.

Greg Schwab spoke up and said he doesn't care where we bank if the staff who work with the feel comfortable with the bank and the county is getting competitive interest. No decision was made.

Job Development was discussed again. The board is struggling to get enough members at meetings for a quorum. The board needs to have a minimum of 10 members and a max of 20 members.

Procedures were discussed. What should happen if employees need an answer between commission meetings. Olerud moved, seconded by Bishop to give Chair Greg Schwab authority to make emergency decisions. All aye. Motion carried.

Olerud mentioned leafy spurge seems to be growing rampant and they will ask the weed board to spray.

The board would like to invite Jay Anderson to another meeting to see if there are any updates on the water project.

With nothing further to come before the board Olson moved, seconded by Anderson to adjourn the meeting at 3:10pm

ATTEST:

Nicole R. Gentzkow Ransom County Auditor	Greg Schwab, Chairman Ransom County Commission

RANSOM COUNTY BOARD OF COMMISSIONERS

Regular Meeting – June 17, 2025

The meeting was called to order at 9:00am by Chair Greg Schwab. The Pledge of Allegiance was recited. Members present: Todd Anderson, Neil Olerud, Sye Olson, Kevin Bishop, and Greg Schwab. Also present: Auditor Nicole Gentzkow and Lynn Kaspari from the Ransom County Gazette. Joining via Teams: Maria Langland, Nickela Runck, Kathie Erickson, Darla Haecherl, Kirsten Gilbert, Teresa Haecherl, Jenna Olerud, Jorge Gonzalez, Janelle Mairs, and Heidi Enquist.

Agenda was reviewed. Banking was added to the agenda. Bishop moved to approve the agenda with the addition, seconded by Olerud. All aye. Motion carried.

Minutes from the previous regular scheduled commission meeting on June 3, 2025 were reviewed. Bishop moved, seconded by Anderson to approve the commission minutes from June 3, 2025. All aye. Motion carried.

Commission Audit Listing in the amount of $138,630.19 were reviewed. Olerud moved, seconded by Anderson to approve all the bills pending Lesmeister's gravel bill until they can talk to Schultz to clear up some confusion. All aye. Motion carried.

BEAR CREEK GRAVEL	9,299.64
CARDINAL HEALTH 110, INC.	3,500.30
CASS COUNTY GOVERNMENT	1,974.69
COUNTIES PROVIDING TECHNOLOGY	3,117.00
DAKOTA OASIS	325.00
DICKEY RURAL NETWORK INC.	1,179.57
ERICKSON, KATHIE	248.50
FLOOR TO CEILING CARPENTRY & REPAIR	10,086.00
GENTZKOW, NICOLE	292.20
GILBERT, KIRSTEN	50.00
GORDYS GRILL & FILL	45.87
HEGLE, KELSEY	186.90
HENRICKS, TYLER	340.00
INFORMATION TECHNOLOGY DEPT.	1,891.05
JONES, CHELSEY	328.20
KELLY, FALLON M.	1,016.16
LANGLAND, MARIA	66.00
LARSON, MEGHAN	109.90
LESMEISTER GRAVEL	94,789.17
LEXISNEXIS MATTHEW BENDER	100.31
OFFICE OF ATTORNEY GENERAL-1250	180.00
QUAL, ANGELA	250.00
RANSOM COUNTY GAZETTE	490.08
RECORD KEEPERS, LLC	37.50

S/J PLUMBING	2,933.00
SARGENT COUNTY DISTRICT HEALTH UNIT	458.25
SARGENT COUNTY SHERIFFS DEPARTMENT	100.00
SKRAMSTAD, RONDA	245.00
TRIZETTO PROVIDER SOLUTIONS	90.00
TYLER TECHNOLOGIES INC.	3,388.00
WALK-N-ROLL	496.76
WEIDNER, SAMANTHA	87.24
WELTON, BRENNA	172.00
WEX HEALTH, INC.	50.00
WILTSE, CAYLA	34.30
ZIMPRICH, BRIAN	671.60
Total	138,630.19

Greg Schwab let the board know the 911 tower is infested with mice and something has to be done to the building.

9:30 AM Continuation of the County Equalization Meeting:

09-3921000 Dan Spiekermeier property was discussed again. Teresa Haecherl Tax Director let the board know the increase in his value was due to inaccurate road miles given that were corrected. Spiekermeier was also give a woodland modifier and he doesn't qualify for that; he only has a tree belt. Anderson moved, seconded by Bishop to leave the road as is and assess the tree belt properly. Roll Call vote: Bishop – yes, Olson – yes, Olerud – yes, Anderson – yes, and Schwab – yes. Teresa Haecherl sent letters and documentation to Spiekermeier explaining. 13-3996000 Susan Dopp and Michael Martin's property was discussed. Teresa Haecherl went out and reassessed the property. Haecherl is lowing the true and full value from $400,600 to $375,600. 26-6714000 Howard Rasmusson's property was reviewed. Teresa Haecherl recommended keeping it as previously assessed. The reason for the change in valuation on Rasmusson's property is it went from 100% exempt to fully taxable. The Tetzlaff/Dakota Sun property was reassessed. Teresa Haecherl gave a 50% obsolescence which is $2500 decrease while the property is being remodeled. Olerud moved to approve the tabled assessments from the previous county equalization meeting on June 3, 2025, seconded by Anderson. All aye. Motion carried. Teresa Haecherl then let the board know the ag land is coming in at 99.999% she recommends decreasing ag land 5% across the board. Bishop moved, seconded by Anderson to reduce ag land 5% to put it at 95%. Roll call vote: Bishop – yes, Olerud – yes, Olson – yes, Anderson – yes, Schwab – yes. Motion passed. Residential structures came in at 90.01% Teresa Haecherl recommended increasing the residential structures 2.4% in cities and townships excluding Liberty and Moore Township as they had just been reassessed. Bishop moved, seconded by Andreson to increase residential structures 2.4% to make them 92.5% with the

exception of Liberty and Moore Township. All aye. Motion carried. Bishop moved, seconded by Olerud to adjourn the Ransom County Equalization Meeting. All aye. Motion carried.

Jerry Ramerman joined via Teams at 9:50am

Jason Enger, Jennifer Lund, Kris Mairs, and Brent Heller with Bremer Bank appeared before the board to discuss banking options with Bremer. The representative from Bremer let the board know that there will be a name change coming January 2026. Nothing will change besides the name, the products and personnel will still be the same.

Robbie Hopkins joined the meeting via Teams at 10:29am

Steve Mclaen and Wyatt Smyth appeared before the board to discuss banking options with Stockgrowers.

11:00 AM MOTOR GRADER BID OPENING

Two bids were received for Motor Graders.

RDO	772	$441,000
RDO	672	$419,000
Butler	140	$419,500
Butler	150	$422,500

RDO offered $85,000 for the spare machine the board is considering trading in. Butler offered $72,000 for the motor grader trade. No decisions were made, Schultz will review specs.

Brian Zimprich appeared before the board to let them know they interviewed two individuals, neither of them were the right fit. They have three more candidates being interviewed in the next week. The earliest the new candidate would start would be August 1, 2025. Zimprich asked if they could hire fair help starting July 7, 2025 – the fair due to being down a person. Anderson moved, seconded by Olerud to allow NDSU Extension to hire an individual from July 7 through the fair at $20 per hour and take from their budget. All aye. Motion carried.

Kathie Erickson appeared before the board to present a motor vehicle contract. Erickson stated not much had changed in the contract. The new contract would be for 5 years. Bishop moved, seconded by Olson to approve the Chair to sign the five-year motor vehicle contract. All aye. Motion carried.

Teresa Haecherl appeared before the board to ask for another full-time employee. Haecherl let the board know there were some changes in the legislative session that have added a few more

duties to her office. Haecherl also let the board know that Kristie Reinke will be done helping in her office at the end of the year. No decision was made at this time.

Ryan Green was on the agenda for delinquent taxes. He did not show up.

Scott Smyth with KLJ appeared before the board to let them know Industrial Builders was the lowest bidder for the McRitchie Bridge. Smyth also let the board know he had done a little research the it would be roughly $50,000 to have KLJ engineer the Sheldon Shop. Discussion was had. Anderson moved, seconded by Olerud to reject all previous bids on the county shop and rebid a smaller size to avoid engineering fees. All aye. Motion carried. Anderson moved, seconded by Olson to rebid the county shop at 36 x 60. All aye. Motion carried. Smyth also let the board know that the Anslem Bridge is officially open. The new speed limit is 45 MPH.

Schultz let the board know the paving projects the county had contacted Knife River to do will be done around July 7. HWY 58 will be closed for two days for Adam to do the prep work needed and install culverts. Mastic was discussed again. Olson moved, seconded by Olerud to do the mastic on county road 57, the Elliott Road, and county road 13 from Fort Ransom to the state park. Roll call: Bishop – yes, Olson – yes, Olerud – yes, Andrson – yes, and Schwab – no. Motion passed. Discussion was had on the Milnor, McLeod, and Elliott roads. The board asked Scott Smyth to get bids for the roads.

Cass County Electric submitted a utility permit for boring. Olerud moved, seconded by Bishop to approve the utility permit pending Adam Schultz approval and the fee. All aye. Motion carried.

VFW Auxiliary submitted a local gaming permit along with the appropriate fee for a raffle. Bishop moved, seconded by Olson to approve the local gaming permit. All aye. Motion carried.

Stiklestad submitted a request to move their liquor/beer license to the learning center for an event along with the appropriate fee. Bishop moved, seconded by Olson to approve the permit. All aye. Motion carried.

The county received notice of a credit with CHS. Olerud moved, seconded by Anderson to have CHS fill the courthouse tank using the credit. All aye. Motion carried.

Bank North and American Bank and Trust will be invited to the next commission meeting to discuss banking options they can offer the county.

The meeting to form an Ambulance District will be June 20, 2025 in the basement of the Bank North building at noon.

Bishop moved, seconded by Olson to adjourn the meeting at 2:12pm. All aye. Motin carried.

Document J

Gmail

Susan Dopp <bonanza7940d@gmail.com>

une 17, 2025 Ransom County Minutes

Susan Dopp <bonanza7940d@gmail.com> Mon, Jul 28, 2025 at 7:18 PM
To: c37auditor@nd.gov

Ransom County Auditor Gentzkow:

I am prepping for the State Board of Equalization Meeting next month and am securing copies of minutes of pertinent Ransom County (RC) Commissioner meetings. In the 6.17.25 minutes posted on the RC website it states: "Susan Dopp and Michael Martin's property was discussed. Teresa Haecherl went out and reassessed the property. Haecherl is lowing the true and full value from $400,600 to $375,600." Shouldn't it be "lowering?" Also, Deputy Tax Director Briss and her intern were the individuals who came out for the 2nd inspection.

Since the state requires evidence that I attended the appropriate meetings, it is important for me to be listed as an attendee in the June 17, 2025 minutes in the some manner. Here's what is included in the June 17, 2025 minutes: "The meeting was called to order at 9:00am by Chair Greg Schwab. The Pledge of Allegiance was recited. Members present: Todd Anderson, Neil Olerud, Sye Olson, Kevin Bishop, and Greg Schwab. Also present: Auditor Nicole Gentzkow and Lynn Kaspari from the Ransom County Gazette. Joining via Teams: Maria Langland, Nickela Runck, Kathie Erickson, Darla Haecherl, Kirsten Gilbert, Teresa Haecherl, Jenna Olerud, Jorge Gonzalez, Janelle Mairs, and Heidi Enquist." Please note my name is only mentioned in reference to the real estate and NOT to the fact I attended this meeting. ***I need you to provide written proof that I attended this meeting since it is not listed. Thank you, in advance, for doing this before July 31, 2025.

The June 4, 2025 minutes state after the the equalization meeting beginning time is given, and, therefore, provide the "evidence deemed necessary to validate the appeal of assessment" (a direct quote from Amber Hasenyager, Administrative Assistant, Property Tax Division, ND Office of State Tax Commissioner in the requested submissions I have to provide. Also, it should state, "Residents" or at least [sic] behind the word "Residence" to indicate people not a place): **"Residence at the equalization Grant Dick, Leon Pfingsten, Joe Mathern, Susan M. Dopp, Howard Rasmusson, Tyler Schlecht, Dan Spiekermeier, Kurt and Tammie Tetzlaff, Hans & Alyssa Schommer, Calvin and Lisa Soffel."**

Regards,
Susan Dopp

NOTICE OF INCREASE IN REAL ESTATE ASSESSMENT

OFFICE OF STATE Tax Commissioner
SFN 24743 (7-2023)

Document B

Name of Township/City/District	County
LIBERTY TOWNSHIP	RANSOM

Property Owner/Address	Real Estate Description
MICHAEL J MARTIN & SUSAN M DOPP 13291 55TH ST SE ENDERLIN, ND 58027	13-3996000 SECT-06 TWP-136 RANG-055 SE1/4 TRACT 160.00 ACRES

Current Year Assessment *(Year)*		True and Full Value
2025		400,600
Previous Year Assessment *(Year)*		True and Full Value
2024		299,400
Change in Assessment	Percentage	True and Full Value
ESTIMATED $1,014 INCREASE TO 2025 TAX STATEMENT		101,200
Reason for Increase in Value		
LIBERTY TOWNSHIP REASSESSMENT		

You are hereby notified in accordance with North Dakota Century Code, the true and full valuation on property you own has increased since the previous year's assessment to one or more of the following levels:

- [x] The assessor has increased the true and full valuation to a level of 10% or more and $3,000 or more from the previous year's assessment.
- [ ] The township, city, or county board of equalization proposes to increase the true and full value returned by the assessor resulting in a cumulative increase of more than fifteen percent from the amount of the previous year's assessment.
- [ ] The township, city, or county board of equalization, or action by the State Board of Equalization has increased the true and full valuation to a level of 10% or more and $3,000 or more from the previous year's assessment.

An increase in assessment may mean that your property taxes will increase. The taxing district must base its tax rate on the number of dollars raised from property taxes in the previous taxable year by the taxing district. By August 31 each year the county shall provide an estimated tax statement to the owner of each parcel with a total estimated tax of at least $100.

Hearing Schedule

Unless the increase results from actions taken by the State Board of Equalization, a property owner may appeal the current year's assessment by contacting the assessor or the boards of equalization. The equalization boards will hold hearings as follows:

Township/City Board of Equalization	Hearing Location	Date	Time
LIBERTY TOWNSHIP	RANSOM COUNTY COURTHOUSE	4/14/2025	4:00 PM
County Board of Equalization	**Hearing Location**	**Date**	**Time**
RANSOM COUNTY	RANSOM COUNTY COURTHOUSE	6/3/2025	10:00 AM
State Board of Equalization	**Hearing Location**	**Date**	**Time**
BISMARCK	STATE CAPITOL	8/12/2025	8:00 AM

Name of Assessment Official		Date
TERESA HAECHERL		3/25/2025
Mailing Address		Telephone Number
PO BOX 830		701-683-6116
City	State	ZIP Code
LISBON	ND	58054

Assessment increase notice to property owner

1. a. When any assessor has increased the true and full valuation of any lot or tract of land including any improvements to an amount that is an increase of $3,000 or more and 10% or more from the amount of the previous year's assessment, the assessor shall deliver written notice of the amount of increase and the amount of the previous year's assessment to the property owner at the expense of the assessment district for which the assessor is employed. Delivery of written notice to a property owner under this subdivision must be completed at least 15 days before the meeting of the local board of equalization.

   b. If written notice by the assessor was not required under subdivision a and action by the township, city, or county board of equalization or order of the state board of equalization has increased the true and full valuation of any lot or tract of land and improvements to an amount that results in a cumulative increase of $3,000 or more and 10% or more from the amount of the previous year's assessment, written notice of the amount of increase and the amount of the previous year's assessment must be delivered to the property owner. The written notice under this subdivision must be mailed or delivered at the expense of the township, city, or county that made the assessment increase or at the expense of the township, city, or county that was ordered to make the increase by the state board of equalization. Delivery of written notice to a property owner under this subdivision must be completed within 15 days after the meeting of the township, city, or county board of equalization that made or ordered the assessment increase and within 30 days after the meeting of the state board of equalization, if the state board of equalization ordered the assessment increase.

   c. The Tax Commissioner shall prescribe suitable forms for written notices under this subsection. The written notice under a subdivision must show the true and full value of the property, including improvements, that the assessor determined for the current year and for the previous year and must also show the date prescribed by law for the meeting of the local board of equalization of the assessment district in which the property is located and the meeting date of the county board of equalization.

   d. Delivery of written notice under this section must be by personal delivery to the property owner, mail addressed to the property owner at the property owner's last-known address, or electronic mail to the property owner directed with verification of receipt to an electronic mail address at which the property owner has consented to receive notice. See North Dakota Century Code (N.D.C.C.) § 57-02-53. Printed 57-02 (01-53)

Limitation on increase

The board of a township, city, or county may not increase the valuation returned by the assessor to an amount that results in a cumulative increase of more than 15% from the amount of the previous year's assessment without giving the owner or the owner's agent reasonable notice and opportunity to be heard regarding the intention of the board to increase it.

Township Board of Equalization

The township board of equalization consists of the members of the township board of supervisors. The board shall meet annually at its usual meeting place within the month of April. At least 10 days before the meeting, the township clerk posts a notice at the usual meeting place and publishes a notice in the official newspaper of the township. The notice must state the meeting time and day in April. See N.D.C.C. § 57-09-01. Printed 57-09 (01-06)

City Board of Equalization

The city board of equalization consists of the members of the city governing body. The board shall meet annually at its usual meeting place within the first 15 days of April. However, if a person is the assessor for two or more cities or townships, the city auditor, after consulting with the assessor, sets an alternate date in April for the equalization meeting. At least 10 days before the alternate meeting, the city auditor posts a notice at the usual meeting place and publishes a notice in the official newspaper of the city. The notice must state the meeting time and day in April. See N.D.C.C. § 57-11-01.

County Board of Equalization

The county board of equalization consists of the members of the county commission and meets within the first 10 days of June of each year at its usual meeting place to review and equalize assessments. See N.D.C.C. §§ 57-12-01 and 57-14-08(3).

State Board of Equalization

Printed (01-09) (01-08)

The state board of equalization meets annually on the second Tuesday in August on the grounds of the state capitol to examine and compare the assessments of taxable property as returned by the counties in the state. The board proceeds to equalize the values so that all assessments of similar taxable property are uniform and equal throughout the state at the true and full value as required by law.

In equalizing individual assessments, the board may reduce the assessment on any separate piece or parcel of real estate if the taxpayer appealed the assessment to the board either by appearing personally or by a representative before the board or by mail or other communication to the board to explain the reasons for requesting the reduction. The board does not have the authority to reduce an assessment unless the taxpayer has first appealed the assessment to the township or city board of equalization and county board of equalization where the property was assessed. See N.D.C.C. §§ 57-13-03 and 57-13-04 and, in the case of a new assessment, § 57-14-08(6). North Dakota Century Code § 57-14-08(6) provides that the State Board of Equalization may reduce a "new" assessment if the owner first appealed to the county board of equalization (does not require going before local equalization board.) (01-08

9. A property owner may appeal the assessment, classification, and exempt status of the owner's property to the state board of equalization if the property owner was foreclosed from attending assessment proceedings because of the failure to substantially comply with the notice requirements in N.D.C.C. Chs. 57-02 or 57-12, or because of an irregularity in the township, city, or county assessment proceedings.

New reassessment of property - Allowance (See N.D.C.C. § 57-14-08)

1. Upon the filing of a petition signed by not less than 10 freeholders in a political subdivision, or by the governing body of that subdivision, requesting a new assessment of property in the subdivision or upon investigation by the board of county commissioners, the board of county commissioners, before October 1, may order a new assessment of any class of property, or of all property, located within the subdivision or within any subdivision. The state board of equalization or the Tax Commissioner may order a new assessment of any class of property or all property located in any political subdivision. The new assessment and equalization must be conducted under the terms and conditions as set forth in the state board of equalization or Tax Commissioner's order. The local governing body responsible for performing the new assessment may petition the state board of equalization or Tax Commissioner for a modification of any or all of the order's terms and conditions. The state board of equalization or Tax Commissioner may for good cause shown grant all or part of the modification request.

Document C

December 23, 2024
Office of Governor

The Honorable Kelly Armstrong
Governor of North Dakota
600 East Boulevard Avenue
Bismarck ND 58505.0001

Dear Governor Armstrong:

North Dakota's recent November referral to dispose property taxes failed. I believe you, as the state's newly elected governor, have stated you hear the message and will lead an effort to reform property taxes. Please read what follows.

In the several years following COVID Enderlin, North Dakota (population 875) lost 14 businesses. This includes a grocery store, pharmacy and lumberyard and all 3 have a heritage going back to Enderlin's founding in 1891. Our healthcare is backstopped by Sanford Medical, driven by an ever-thickening policy handbook with no local management. A 55 mile one-way trip to a Sanford specialist for a follow-up appointment is often the result so you better have a reliable car. My wife and I live on a farm 1.5 miles west of Enderlin and the road is washboard gravel. After a snow dump, we feel blessed if a township plow is seen within days. Two winters ago we went without rural mail delivery for 16 days straight. If I am tangled in a hay baler, the first responders are community volunteers, despite 18% of the nation's GDP gobbled up by healthcare. Sheriff response is 10 to 45 minutes away, depending on the position of a deputy in our county. Our local newspaper-the Enderlin Independent- has a paid circulation of around 300 (a fraction from even 10 years ago) and readership is dropping like a rock. Our local public school's budget comes in at $16,000/student and K-12 enrollment has dropped from 435 (when student cost was $6,800) 22 years go to a static 300 today. And this is after a dissolution of a neighboring smaller school district. Put it all together, and a rural resident has never paid more and got less. Historian Victor Davis Hanson describes it as "decivilization" and that is a very apt description of the rural North Dakota world.

Of course, the frosting on the cake is the annual property tax statement. Despite no substantial improvements on our land, this fall we were notified our property tax bill jumped 10%. Contrast that to the Fed's claim the current inflation rate is 2.8%. If you are a careful reader you can see where my bitterness comes from. We pay more, get less, quality tanks and all layers of local, county and state government think the solution is raise property taxes. They honestly believe they are doing a helluva job. They are not.

The establishment's reaction to the property tax referral was of their ox being gored. I know of no one who objects to the concept of property tax but they strongly oppose the

current formula which doesn't guarantee moderate and doable increases. Obviously, the opposition is against a rigged formula which is a guaranteed never ending cash cow. This easy source of government revenue is manipulated by an unfocused government whose imagination ends with annual budget increases. Record land prices indirectly push valuation only upward and government smiles. I don't. In addition, because we are a small farm we must have off-farm income to make a living. With off-farm income our buildings are taxed. Odd, isn't it, out county and state government's Byzantine tax formula is destroying small farms with this additional tax penalty? Exactly how serious is North Dakota in keeping people on the land? 3 of our out buildings were given to us if we moved them. This summer, county courthouse people (3) were in our yard with a measuring wheel determining building size. Of course square feet replacement cost factors in rather than the free purchase price. I paid nothing but my labor, but an arrogant government always knows best and always assigns a much bigger number that only benefits them. I actually pay more property taxes on my gifted mule barn than my neighbor, a big farmer, pays on his half million dollar farm shop. Explain in less than 5 pages how that is even in the same zip code as fair?

In summary, government controls the property tax formula and I see no cap, no empathy and no effort at serious reform. The November referral shows I am not alone in my thinking and your winning the governor's office is an opportunity to bring some sanity to the whole shebang. One of the greatest mysteries to me is why the whole stinking mess hasn't been brought into our state Supreme Court for a cram down fix. And if you can't bring balance to property taxes I for one will be happy to see a solution coming from a higher court.

A good place to start would be county government guaranteeing local groceries and a pharmacy when it assesses local taxes. At least give us benefits we can be proud of and benefits which were here 130 plus years ago.

Taking and not providing always ends up badly. History proves my point. I am

Sincerely yours,

Mike Martin
13291 55th ST SE
Enderlin ND 58027
701.437.3259

13291 55TH ST SE, ENDERLIN

Deed: **MARTIN/MICHAEL J/& SUSAN M DOPP**
Contract:
CID#:
DBA:
MLS:

Map Area: **LIBERTY-R**
Route: **00-000-000**
Tax Dist: **24-01-00**
Plat Page:
Subdiv: **NONE**

Checks/Tags:
Lister/Date: **WS, 03/09/2010**
Review/Date:
Entry Status: **Inspected**

Rural / Residential

Legal: SECT-06 TWP-136 RANG-055 SE1/4-6-136-55

Land

Land Basis	Front	Rear	Side 1	Side 2	R. Lot	SF	Acres	Depth/Unit	EFF/Type	Qual./Land	Unit Price	Total	Topo	Econ	Other	$Adj	Land Total (Rnd nearest $100)
Tiered Acres																$0	
Tier 1						43,560.00	1.000				$20,000.00						
Tier 2						43,560.00	1.000				$2,000.00						
Subtotal						87,120.00	2.000					$22,000	0%	0%	0%	$0	$22,000
Ag Land							158.000					$184,600	0%	0%	0%	$0	$184,600
Grand Total						6,969,600.00	160.000					$206,600					$206,600

	Street	Utilities	Zoning	Land Use
Tiered Acres	None	Rural	Residential Single Family	Residential
Ag Land	None	None	Not Applicable	Not Applicable

Sales

Date	$ Amount	NUTC	Recording

Building Permits

Date	Number	Tag	$ Amount	Reason

Values

Type	Appraised	B of R	St. Equalized	Pr Yr: 2024
Land	$206,600	$190,200	$0	$190,200
Dwlg	$215,600	$90,800	$0	$90,800
Impr		$0	$0	
Total	$422,200	$281,000	$0	$281,000

Res. Structure

Occ. Code	101
Occ. Descr.	Single-Family / Owner Occupied
Year Built	1960
EFA / EFYr	65 / 1960
Arch. Dsgn	Ranch
Style	1 Story Frame
AreaSF/TLA	1,400 / 1,400
GLA 1st/2nd	1,400 / 0
Grade	4+10
Grade Mult.	1.210
Condition	NML
Phy-Depr.%	27%
Basement	Full
No Bsmt Flr.	0
Heat	FHA - Gas
AC	Yes
Attic	None

Finish

Ttl Rooms Above #	6	Bedrooms Above #	2
Ttl Rooms Below #	4	Bedrooms Below #	1
Minimal Finish	700		$14.00
Living Qtrs. (Multi)	700		$27.75

Foundation	C Blk
Exterior Walls	Steel Siding
Roof	Asphalt/Gable
Interior Finish	Plaster
Flooring	Carp/Lino/Tile

Non-base Heating

Floor/Wall #	0
Pipeless #	0
Hand Fired (Y/N)	No
Space Heat #	0

Fireplace

Appliances

Range Unit	Built-In Vacuums
Oven - Single	Intercom System
Oven - Double	BI Stereo(SpkrsOnly)
Dishwasher	Garbage Disposal
Microwave	Range Hood
Trash Compactor	
Jennair	
Security System	

Plumbing

Standard Bath - 3 Fixt	1
3/4 Bath	
1/2 Bath	1
Lavatory	
Toilet	
Sink	
Shower Stall/Tub	
Mtl St Sh Bath	
Mtl Stall Shower	
Wet Bar	
Cust Bath - 3 Fixt	
Custom Tub	
No Hot Water Tank	
No Plumbing	
Sewer & Water Only	
Water Only w/Sink	
Hot Tub	
Bidet	
Fbgls Service Sink	
Urinal	
Sauna	
Cust Bath - 4 Fixt	
Cust Tile Full Bath	
Cust Tile SS Bath	
Cust Bath - 5 Fixt	
Cust Tile Shower/Tub	
Cust Tile SSB +lav	
Cust Tile SSB w/Std Tub	
Cust Tile SSB - 5 Fixt	
Cust Bath +lav	
Cust Bath w/Cust SS	
Cust Bath w/Cust SS +lav	
Plumbing Extras	

Addition

Addition	No Additions
Year Built	
EFA	
EFA Year	
Style	
Area (SF)	
Condition	
Phy-Depr.%	
Bsmt (SF)	
NoBsmt Flr(SF)	
2nd Flr Adj.	
Heat	
AC	
Attic (SF)	

Obsolescence

Functional %	0%
External %	0%
Other %	0%

None
None
None
None

Garage

Garage	1 of 3
Year Built	1960
EFA	65
EFF Year	1960
Style	Att Fr.
W X L	0' X 0'
Area (SF)	364
No Flr Adj.	No
Grade	Main Building
Condition	NML
Bsmt (SF)	
Interior Finish	<None>
Interior Finish (SF)	
Qtrs Over	None
Qtrs Over (SF)	
Qtrs AC (SF)	
%Phy/F-E-O Obs	27.00-0-0-0
Door Opnrs	
Stalls- Bsmt / Std	

Bldg / Addn		Description (RCN $246,036)		Units	Price	Base Value	Grade Mult	Year	Phys%	Fobs%	Eobs%	Other%	Depreciated Total (Rnd nearest dollar)	Map	Appraised Value (Rnd nearest $100)
		101 – Single-Family / Owner Occupied													
		1 Story Frame		1,400		$149,740									
	#1	Bsmt Fin - Minimal Finish (Avg)		700 Tbl	$14.00	$9,800									
	#2	Bsmt Fin - Living Qtrs. (Multi) (Avg)		700 Tbl	$27.75	$19,425									
		Base Heat: FHA - Gas													
		Add Central Air		1,400	$3,620.00	$3,620									
		Plumbing		2	N/A	$5,500									
	Gar	Att Frame		364 SF		$15,250	1.210	1960	27.00						
		Building Sub Total				**$203,335**	1.210	1960	27.00	0	0	0	**$179,606**		
	Gar	Det Frame	0' X 0'	255 SF		$10,410	5	1975	55.00	0	0	0	**$4,122**		
	Gar	Det Frame	0' X 0'	1,296 SF		$35,229	5	1970	62.00	0	0	0	**$11,781**		
		Building TOTAL Value											**$195,509**	**1.000**	**$195,500**

		Description	Units	Price	Base Value	Cond	Year	Phys%	Fobs%	Eobs%	Other%	AgFctr%	Depreciated Total (Rnd nearest dollar)	Map	Appraised Value (Rnd nearest $100)
	Yrd	1 — Driveway		$2,400.00	$2,640	NML	1960	65.00	0	0	0	0%	$924	1.000	$900
	D	Concrete-single, Std Nml													
	Yrd	1 — Sheds and Yard Structures		$26.00	$41,184	NML	1970	65.00	0	0	0	0%	$14,414	1.000	$14,400
	D	W36.00 x L40.00 1,440 SF, Fr. Shed, Avg Pricing													
	Yrd	1 — Sheds and Yard Structures		$26.00	$13,585	NML	1970	65.00	0	0	0	0%	$4,755	1.000	$4,800
	D	W19.00 x L25.00 475 SF, Fr. Shed, Avg Pricing													
		Yard Extras TOTAL Value													**$20,100**

Prior Year	Comment	Value Type	Location	Class	Land Value	Dwelling Value	Improvement Value	M & E Value	Total Value
2024	2020 Manual Migration 8/21/2024	BofR	Rural	Res	$190,200	$90,800	$0	$0	$281,000
2023	VAI Import from 2023 file.	Import			$190,200	$90,800	$0	$0	$281,000
2022	VAI Import from 2022 file.	Import			$176,000	$87,700	$0	$0	$263,700
2021	VAI import from 2021 file	Import			$176,000	$87,700	$0	$0	$263,700
2020	VAI Import from 2020 file	Import			$175,800	$85,100	$0	$0	$260,900
2019	VAI Import from 2019 file	Import			$169,300	$85,100	$0	$0	$254,400
2018	VAI Import from 2018 file	Import			$169,300	$85,100	$0	$0	$254,400
2017		Import	Rural	Ag Land	$151,500	$85,100	$0	$0	$236,600
2016		Import	Rural	Ag Land	$151,500	$81,500	$0	$0	$233,000
2015		Import	Rural	Ag Land	$148,700	$76,000	$0	$0	$224,700
2014		Import	Rural	Ag Land	$139,300	$70,400	$0	$0	$209,700
2013		Import	Rural	Ag Land	$126,000	$69,000	$0	$0	$195,000
2012		Import	Rural	Ag Land	$117,100	$61,600	$0	$0	$178,700
2011		Import	Rural	Ag Land	$94,000	$50,900	$0	$0	$144,900
2010		Import	Rural	Ag Land	$90,700	$46,700	$0	$0	$137,400
2009		Import	Rural	Ag Land	$86,600	$46,700	$0	$0	$133,300

"studio" She/Shed

Man Shed

Det/Garage Taxable

Det/Garage

AG USE #1

Ag USE #2

Ag Use #3

Ag USE #3

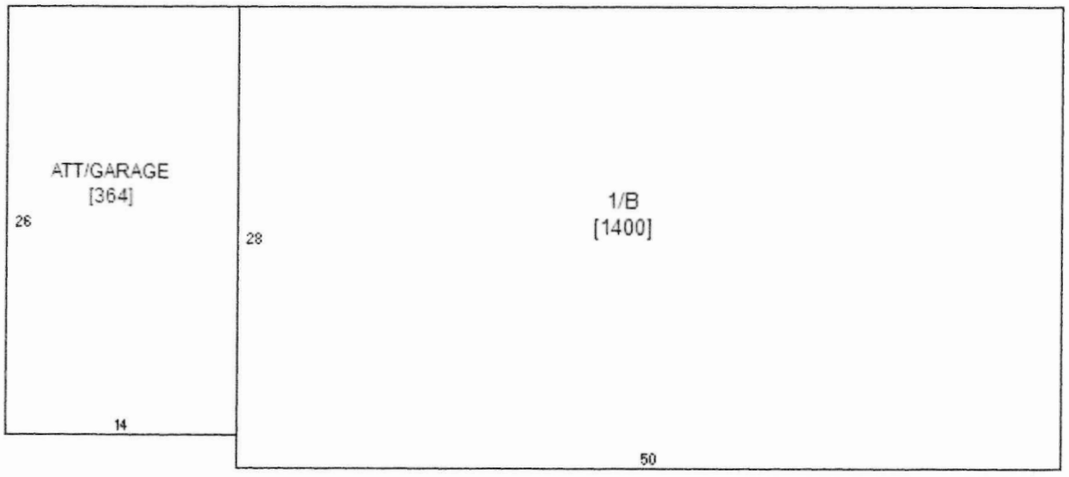
Ag Use #4 Barn

Ag Use #5

Chicken Coop

Notes:

12/03/2024 - "Studio" is taxable, used as a dog kennel on the bottom and a office work area on the top floor. I entered this in as a shed, labeled it She/Shed. I did the same with Micheal's shed, labeled it as a
Man/Shed. I also put the small det/garage next to the Machine building on the tax roll, and the Long Det/garage on the tax roll as well. I dont see any evidence of ag use with these buildings. There are 6 other
buildings on the property that do look like they are used for livestock, these buildings will remain off the tax roll. TMH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1/B
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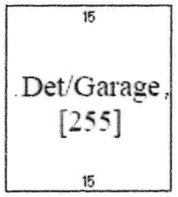
50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Det/Garage
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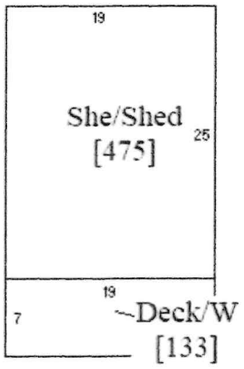
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She/Shed
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19
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Deck/W
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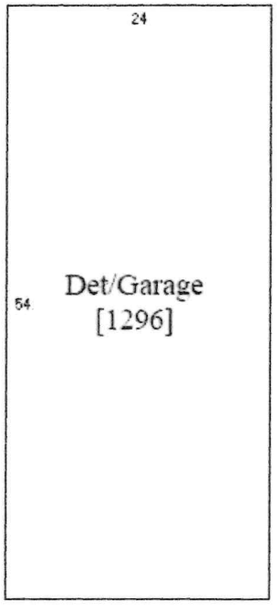
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Det/Garage
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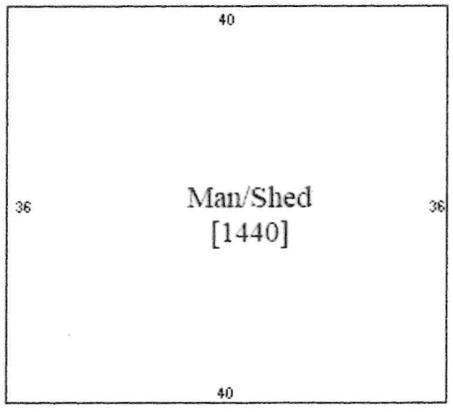
54


40
Man/Shed
[1440]
36
36
40

Document H

PDF+PIN: **013+13-3996000** | **Ransom County, ND Assessor** | **WORKING** | Wed, 6/18/2025, 1:29 PM | Page 1

13291 55TH ST SE, ENDERLIN

Deed: **MARTIN/MICHAEL J/& SUSAN M DOPP**
Contract:
CID#:
DBA:
MLS:

Map Area: **LIBERTY-R**
Route: **00-000-000**
Tax Dist: **24-01-00**
Plat Page:
Subdiv: **NONE**

Checks/Tags:
Lister/Date: **WS, 03/09/2010**
Review/Date:
Entry Status: **Inspected**

Rural / Residential
Legal: SECT-06 TWP-136 RANG-055 SE1/4-6-136-55

Land

Land Basis	Front	Rear	Side 1	Side 2	R. Lot	SF	Acres	Depth/Unit	EFF/Type	Qual./Land	Unit Price	Total	Topo	Econ	Other	$Adj	Land Total (Rnd nearest $100)
Tiered Acres																$0	
Tier 1						43,560.00	1.000				$20,000.00						
Tier 2						43,560.00	1.000				$2,000.00						
Subtotal						87,120.00	2.000					$22,000	0%	0%	0%	$0	$22,000
Ag Land							158.000					$184,600	0%	0%	0%	$0	$184,600
Grand Total						6,969,600.00	160.000					$206,600					$206,600

	Street	Utilities	Zoning	Land Use
Tiered Acres	None	Rural	Residential Single Family	Residential
Ag Land	None	None	Not Applicable	Not Applicable

Sales

Date	$ Amount	NUTC	Recording

Building Permits

Date	Number	Tag	$ Amount	Reason

Values

Type	Appraised	B of R	St. Equalized	Pr Yr: 2024
Land	$206,600	$190,200	$0	$190,200
Dwlg	$187,800	$90,800	$0	$90,800
Impr		$0	$0	
Total	$394,400	$281,000	$0	$281,000

Res. Structure

Occ. Code	101
Occ. Descr.	Single-Family / Owner Occupied
Year Built	1960
EFA / EFYr	65 / 1960
Arch. Dsgn	Ranch
Style	1 Story Frame
AreaSF/TLA	1,400 / 1,400
GLA 1st/2nd	1,400 / 0
Grade	4+10
Grade Mult.	1.210
Condition	NML
Phy-Depr.%	27%
Basement	Full
No Bsmt Flr.	0
Heat	FHA - Gas
AC	Yes
Attic	None

Finish

Ttl Rooms Above #	5	Bedrooms Above #	2
Ttl Rooms Below #	4	Bedrcoms Below #	1
Minimal Finish	700		$14.00
Living Qtrs. (Multi)	700		$22.25

Foundation	C Blk
Exterior Walls	Steel Siding
Roof	Asphalt/Gable
Interior Finish	Plaster
Flooring	Carp/Lino/Tile

Non-base Heating

Floor/Wall #	0
Pipeless #	0
Hand Fired (Y/N)	No
Space Heat #	0

Fireplace

Appliances

Range Unit	Built-In Vacuums
Oven - Single	Intercom System
Oven - Double	BI Stereo(SpkrsOnly)
Dishwasher	Garbage Disposal
Microwave	Range Hood
Trash Compactor	
Jennair	
Security System	

Plumbing

Standard Bath - 3 Fixt	1
3/4 Bath	
1/2 Bath	
Lavatory	
Toilet	1
Sink	
Shower Stall/Tub	
Mtl St Sh Bath	
Mtl Stall Shower	
Wet Bar	
Cust Bath - 3 Fixt	
Custom Tub	
No Hot Water Tank	
No Plumbing	
Sewer & Water Only	
Water Only w/Sink	
Hot Tub	
Bidet	
Fbgls Service Sink	
Urinal	
Sauna	
Cust Bath - 4 Fixt	
Cust Tile Full Bath	
Cust Tile SS Bath	
Cust Bath - 5 Fixt	
Cust Tile Shower/Tub	
Cust Tile SSB +lav	
Cust Tile SSB w/Std Tub	
Cust Tile SSB - 5 Fixt	
Cust Bath +lav	
Cust Bath w/Cust SS	
Cust Bath w/Cust SS +lav	
Plumbing Extras	

Addition

Addition	No Additions
Year Built	
EFA	
EFA Year	
Style	
Area (SF)	
Condition	
Phy-Depr.%	
Bsmt (SF)	
NoBsmt Flr(SF)	
2nd Flr Adj.	
Heat	
AC	
Attic (SF)	

Obsolescence

Functional %	0%
External %	0%
Other %	0%

None
None
None
None

Garage

Garage	1 of 1
Year Built	1960
EFA	65
EFF Year	1960
Style	Att Fr.
W X L	0' X 0'
Area (SF)	364
No Flr Adj.	No
Grade	Main Building
Condition	NML
Bsmt (SF)	
Interior Finish	<None>
Interior Finish (SF)	
Qtrs Over	None
Qtrs Over (SF)	
Qtrs AC (SF)	
%Phy/F-E-O Obs	27.00-0-0-0
Door Opnrs	
Stalls- Bsmt / Std	-- / 1.00

Bldg / Addn		Description (RCN $239,804)	Units	Price	Base Value	Grade Mult	Year	Phys%	Fobs%	Eobs%	Other%	Depreciated Total (Rnd nearest dollar)	Map	Appraised Value (Rnd nearest $100)
		101 – Single-Family / Owner Occupied												
		1 Story Frame	1,400		$149,740									
	#1	Bsmt Fin - Minimal Finish (Avg)	700 Tbl	$14.00	$9,800									
	#2	Bsmt Fin - Living Qtrs. (Multi) (Low)	700 Tbl	$22.25	$15,575									
		Base Heat: FHA - Gas												
		Add Central Air	1,400	$3,620.00	$3,620									
		Plumbing	2	N/A	$4,200									
	Gar	Att Frame	364 SF		$15,250	1.210	1960	27.00						
		Building Sub Total			**$198,185**	1.210	1960	27.00	0	0	0	**$175,056**		
		Building TOTAL Value										**$175,056**	**1.000**	**$175,100**

		Description	Units	Price	Base Value	Cond	Year	Phys%	Fobs%	Eobs%	Other%	AgFctr%	Depreciated Total (Rnd nearest dollar)	Map	Appraised Value (Rnd nearest $100)
	Yrd D	1 — Driveway Concrete-single, Std Nml		$2,400.00	$2,640	NML	1960	65.00	0	0	0	0%	$924	1.000	$900
	Yrd D	1 — Sheds and Yard Structures 1,930 SF, Fr. Shed, Low Pricing		$18.00	$38,214	NML	1995	65.00	0	0	50	0%	$6,687	1.000	$6,700
	Yrd D	1 — Sheds and Yard Structures W19.00 x L25.00 475 SF, Fr. Shed, Low Pricing		$18.00	$9,405	NML	1970	65.00	0	0	0	0%	$3,292	1.000	$3,300
	Yrd D	1 — Sheds and Yard Structures 255 SF, Fr. Shed, Low Pricing		$18.00	$5,049	NML	1975	65.00	0	0	0	0%	$1,767	1.000	$1,800
		Yard Extras TOTAL Value													**$12,700**

Prior Year	Comment	Value Type	Location	Class	Land Value	Dwelling Value	Improvement Value	M & E Value	Total Value
2024	2020 Manual Migration 8/21/2024	BofR	Rural	Res	$190,200	$90,800	$0	$0	$281,000
2023	VAI Import from 2023 file.	Import			$190,200	$90,800	$0	$0	$281,000
2022	VAI Import from 2022 file.	Import			$176,000	$87,700	$0	$0	$263,700
2021	VAI import from 2021 file	Import			$176,000	$87,700	$0	$0	$263,700
2020	VAI Import from 2020 file	Import			$175,800	$85,100	$0	$0	$260,900
2019	VAI Import from 2019 file	Import			$169,300	$85,100	$0	$0	$254,400
2018	VAI Import from 2018 file	Import			$169,300	$85,100	$0	$0	$254,400
2017		Import	Rural	Ag Land	$151,500	$85,100	$0	$0	$236,600
2016		Import	Rural	Ag Land	$151,500	$81,500	$0	$0	$233,000
2015		Import	Rural	Ag Land	$148,700	$76,000	$0	$0	$224,700
2014		Import	Rural	Ag Land	$139,300	$70,400	$0	$0	$209,700
2013		Import	Rural	Ag Land	$126,000	$69,000	$0	$0	$195,000
2012		Import	Rural	Ag Land	$117,100	$61,600	$0	$0	$178,700
2011		Import	Rural	Ag Land	$94,000	$50,900	$0	$0	$144,900
2010		Import	Rural	Ag Land	$90,700	$46,700	$0	$0	$137,400
2009		Import	Rural	Ag Land	$86,600	$46,700	$0	$0	$133,300

"studio" She/Shed #1

Well house/Man Shed #2

Well house/Man Shed #2

Well house/Man Shed #2


Well house/Man Shed #2

Well house/Man Shed #2

Well house/Man Shed #2


Shed #3

AG USE #1

Ag USE #2

Ag Use #3

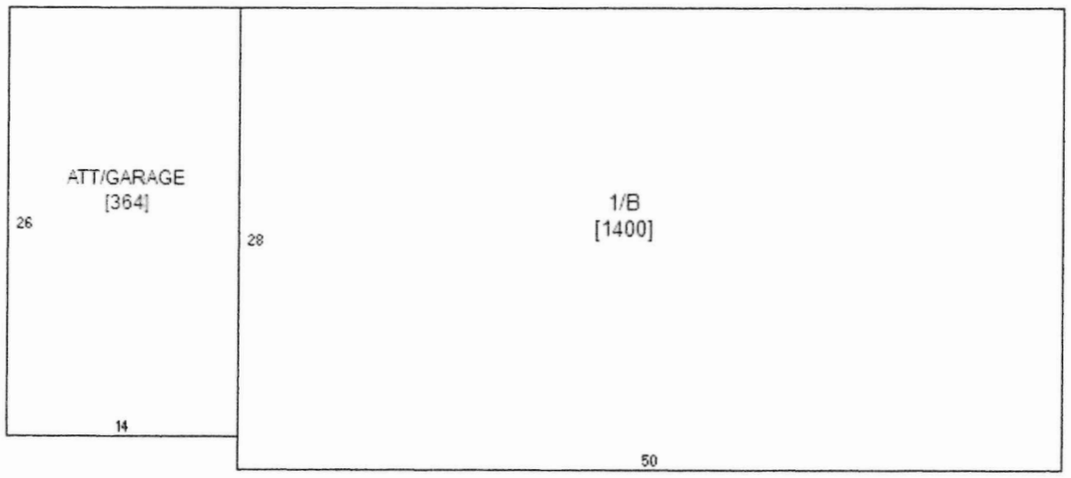
Ag USE #3

Ag Use #4 Barn

Ag Use #5

Shop, houses bobcat amd tractors. not taxed AG Use #6

Chicken Coop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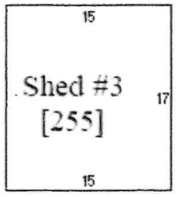
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Shed #3
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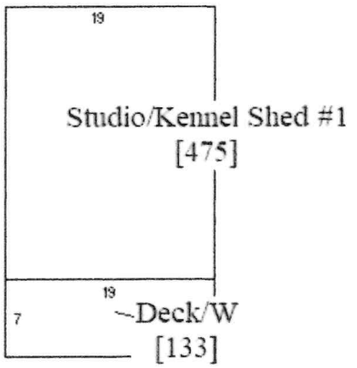
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Studio/Kennel Shed #1
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19
7
Deck/W
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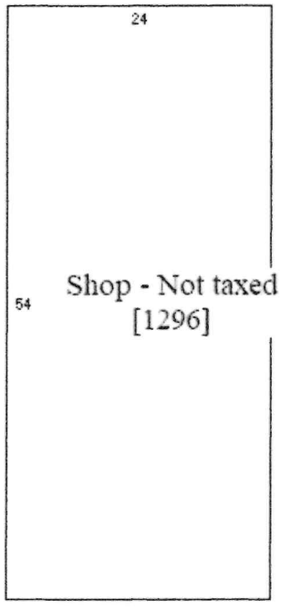
24
54
Shop - Not taxed
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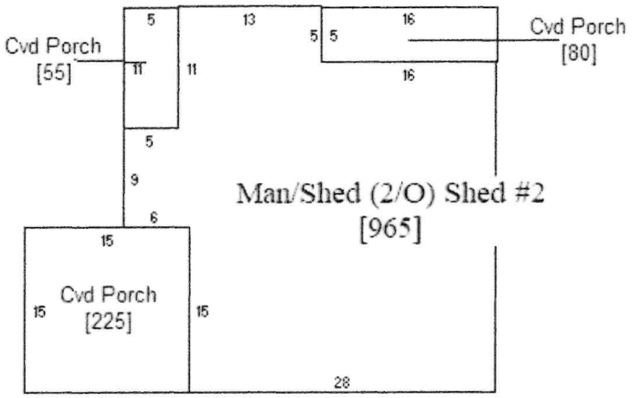
Cvd Porch
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9
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Man/Shed (2/O) Shed #2
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Cvd Porch
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Document E

PROCEEDINGS OF TOWNSHIP BOARD OF EQUALIZATION

THE BOARD MET AT THE OFFICE OF THE TOWNSHIP CLERK AT 4 O'CLOCK P .M, APRIL 14
2025. Commissioners Room Re Courthouse

PRESENT:

Steve Trautman

CHAIRMAN, SUPERVISOR

Copy

Ron Hartl

SUPERVISOR

David Billing

SUPERVISOR

TOWNSHIP CLERK

MINUTES:

Steve Trautman called the meeting to order. A Quorum was declared.

Present were Steve Trautman, Ron Hartl, David Billing, Tax director Teresa Haechert, Deputy tax director Michaela Briss, and guests Mike Martin and Susan Dopp.

Teresa Haechert presented a booklet of several township Residential Sales in Ransom County from Years 2022, 2023 and 2024.

Mike Martin and Susan Dopp had questions concerning how their property was assessed.

Teresa Haechert explained the act sheet on Ransom County land for 2025.

Ron Hartl moved to accept the 37 changes to the tax role as discussed at this meeting. Seconded by Steve Trautman and carried.

Ron Hartl moved to adjourn, seconded by Steve Trautman, motion carried. Meeting adjourned.

I HEREBY CERTIFY THAT THE FOLLOWING IS A CORRECT TRANSCRIPT OF THE TOWNSHIP BOARD OF EQUALIZATION OF Liberty TOWNSHIP, RANSOM COUNTY, ND IN TESTIMONY WHEREOF, I HEREUNTO SET MY HAND THIS 14 DAY OF APRIL 2025

David Billing TOWNSHIP CLERK

CHANGES IN TRUE AND FULL VALUE
USE ONE FORM FOR EACH ASSESSMENT DISTRICT - DO NOT REMIT TO STATE TAX DEPARTMENT
TOTALS FROM EACH DISTRICT ARE ADDED TO THE SUPPLEMENTARY ABSTRACT

ASSESSMENT DISTRICT Liberty FEBRUARY 1, 2024 TO FEBRUARY 1, 2025

PARCEL NUMBER	AGRICULTURAL PROPERTY		RESIDENTIAL PROPERTY				COMMERCIAL PROPERTY				REASONS FOR CHANGE
			LOTS, TRACTS AND LEASED SITES		BUILDINGS AND STRUCTURES		LOTS, TRACTS AND LEASED SITES		BUILDINGS AND STRUCTURES		1. Taxable/non-taxable 2. Locally /State assessed 3. New constr./Demolition 4. Annexation 5. Change in classification 6. New constr./Demolition of exempt prop. 7. Annexation of exempt property
	INCREASE	DECREASE	INCREASE	DECREASE	INCREASE	DECREASE	INCREASE	DECREASE	INCREASE	DECREASE	
13-3971010 HASKIN					74500						8 TWP REASSESSMENT
13-3971020 STOLZ					45400						8 TWP REASSESSMENT
13-3972000 HARTL	57300							28400			5 COM TO AG
13-3972020 BARTHOLOMAY					39400						8 TWP REASSESSMENT
13-3972030 HARTL					41200						8 TWP REASSESSMENT
13-3975010 NELSON					13700						8 TWP REASSESSMENT
13-3987010 MUTH		100	2600								5 AG TO RES
13-3987040 OTTESON			3800								8 "SPLIT" ENDERLIN FIX
13-3987050 MUTH			4600								8 "SPLIT" ENDERLIN FIX
13-3987060 OWENS			4200								8 "SPLIT" ENDERLIN FIX
13-3991000 DEHN									24000		8 TWP REASSESSMENT
13-3993010 BARTELS					33300						8 TWP REASSESSMENT
13-3996000 MARTIN/DOPP					101200						8 TWP REASSESSMENT
13-4001020 FARNHAM					25600						8 TWP REASSESSMENT
13-4004010 KRAFT					11400						8 TWP REASSESSMENT
13-4005010 GOLF COURSE									27500		8 TWP REASSESSMENT
13-4006000 SCHMITZ	1900										8 SPLIT
13-4006020 WENDSCHLAG		600	32300								8 SPLIT
13-4006020 WENDSCHLAG					141800						1 FARM EXEMPT TO TXBL
13-4011020 PRIBBENOW					73300						8 TWP REASSESSMENT
13-4013010 MILLER					9700						8 TWP REASSESSMENT
13-4020000 FROEMKE TRUST						10600					8 VACANT HOUSE/TWP REASSESS
13-4029030 SHISHEHBOR					29100						8 TWP REASSESSMENT
13-4044010 OPATZ					12800						8 TWP REASSESSMENT
13-4045010 BRISS					17900						8 TWP REASSESSMENT
13-4053020 KELLY					28200						8 TWP REASSESSMENT
13-4054000 JOHANNESON					6000						8 TWP REASSESSMENT

"Change Sheet"
Source: EC Twp Director
May 2025
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Document G

BURLEIGH DODDS SERIES IN AGRICULTURAL SCIENCE

Improving grassland and pasture management in temperate agriculture

Edited by Professor Athole Marshall & Dr Rosemary Collins
IBERS, Aberystwyth University, UK

E-CHAPTER FROM THIS BOOK

burleigh dodds SCIENCE PUBLISHING

Restoring degraded grasslands

Llewellyn L. Manske, North Dakota State University, USA

1 Introduction

Grasslands are complex ecosystems comprising numerous biotic and abiotic components. The biotic components are the herbaceous grass and forb plants, soil organisms and grazing graminivores which have biological and physiological requirements. The abiotic components include radiant energy from sunlight; the essential major elements of carbon, hydrogen, nitrogen and oxygen, and the minor essential elements of macro- and micro-minerals required by living organisms. The major elements and some of the minor elements have biogeochemical cycles which transform the elements between organic and inorganic forms. Grassland ecosystems are therefore functioning units of co-acting biotic organisms interacting with the abiotic components and environmental factors (Manske 2014c). Grass plants, soil microorganisms and large graminivores have developed complex symbiotic relationships. The grazing graminivores depend on grass plants for nutritious forage; grass plants in turn depend on rhizosphere organisms for the mineralisation of essential elements (primarily nitrogen) from the soil organic matter; rhizosphere organisms depend on grass plants for energy in the form of the short carbon chains released by grass plants into the rhizosphere following partial defoliation by grazing graminivores. The management of grassland ecosystems must therefore meet the biological and physiological requirements

http://dx.doi.org/10.19103/AS.2017.0024.15

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of the plants, soil organisms and graminivores; stimulate internal plant mechanisms; and enhance the rhizosphere organism biomass and the ecosystem biogeochemical processes that cycle essential elements (Manske 2014c).

Grassland ecosystems degrade when management causes the loss of essential elements to be greater than the capture of replacement essential elements. Conversely, grassland ecosystems aggrade when they are managed so as to make the capture of essential elements greater than the losses (McGill and Cole 1981). A large biomass of soil microbes is required to aggrade grassland ecosystems (Coleman et al. 1983; Schimel, Coleman and Horton 1985; Cheng and Johnson 1998). The soil microorganism biomass can be increased through biologically effective grazing management. Traditional management of grasslands causes a diminution of the functionality of internal grass plant mechanisms and ecosystem biogeochemical processes, resulting in degradation. Therefore, restoration of degraded grassland ecosystems requires returning the primary grass mechanisms and ecosystem processes to potential functioning levels. As an initial step, the rhizosphere organism biomass must be raised to increase the mineralisation of nitrogen and other essential elements. Rhizosphere organisms are limited by accessing energy in the form of short carbon chains. Carbon energy can be released from grass lead tillers through the roots into the rhizosphere by removal of 25–33% of the above-ground leaf biomass by large grazing graminivores when the lead tillers are at the phenological growth stages between the three and a half new leaf stage and the flower (anthesis) stage during early June to mid-July (Manske 1999, 2011b, 2014c). Depending on the degree of degradation of the grassland, three to five or more growing seasons are required to increase the rhizosphere organism biomass to levels capable of mineralising a threshold level of 112 kg/ha or greater of available mineral nitrogen. Research has shown that full activation of internal grass plant mechanisms requires mineral nitrogen to be available at this level. It also requires available carbon fixed through photosynthesis from 67 to 75% of the leaf area of pre-defoliated lead tillers before the flower stage, and from 50% of the leaf area after the flower stage (Manske 2010a,b). An increase in available essential elements permits the grass tillers to synthesise increasing quantities of carbohydrates, proteins and nucleic acids to accelerate growth rates of replacement leaves and shoots, increase photosynthetic capacity of the remaining mature leaves, increase secondary tiller development from axillary buds, enhance the competitiveness of nutrient resource uptake and improve water use efficiency. The combination of increased ecosystem biogeochemical processes and improved functioning of the internal grass plant mechanisms results in increases in grass herbage production and in plant density (basal cover) of the desirable native grass species. Changes in the above-ground vegetation lag behind changes in the soil microorganism biomass and activity when a grassland ecosystem is degrading and also when it is aggrading.

This chapter examines the inter-relationship of species, microbial activity, nutrients and environmental factors in restoring and maintaining the health, sustainability and productivity of grasslands, with particular emphasis on the ecosystem of the Northern Plains of North America. The information presented here was synthesised from research conducted in the Northern Plains and should be directly applicable to all intact grassland regions where perennial grass plants reproduce vegetatively and the plants subsist from growing season to growing season in a low-activity dormancy state when soils are frozen. The Northern Plains ecosystem is part of the North American Interior Plains physiographic region that extends from the foot of the Rocky Mountains eastwards to the Canadian Shield and Appalachian Provinces, and in the north extends from the Athabasca River on the Alberta Plateau southwards to the North Platte-Platte-Missouri River Valleys. The

native vegetation was primarily grasslands which have been separated into four types arranged in north–south zones based on the stature of the major grass species on the silty ecological sites. The native vegetation types from west to east are: short grass, mixed grass, transition (or Eastern mixed grass), and tall grass prairies. Each of these vegetation types has been defined by soil temperature and soil moisture regimes. The two soil temperature regimes are based on mean annual soil temperature: in the north by <8°C (Frigid) and in the south by >8°C (Mesic). The separation between north and south soil temperature regimes is demarcated by a wide belt that extends eastwards along the north border of Wyoming and continues through South Dakota to the boundary of the Oak Forest in western Minnesota. The four soil moisture regimes are based on the mean annual precipitation and the mean length of time the soil is dry during a growing season. Most of the precipitation (75–85%) occurs during the growing season. Precipitation rates increase from west to east. In the north, the range is from 305 mm in the west to 610 mm in the east. In the south, the range is from 356 mm in the west to 813 mm in the east. The number of days the soil is dry during a growing season decreases from west to east. The resulting four soil moisture regimes are: arid (Aridic), semi-arid (Ustic), sub-humid (Udic) and humid (Perudic). Soils of the short grass prairie support vegetation of short grasses with some mid grasses in the north and of short grasses in the south. The major species are: blue grama (*Bouteloua gracilis*), needle and thread (*Hesperostipa comata*), and western wheatgrass (*Pascopyrum smithii*). Soils of the mixed grass prairie support vegetation of mid and short grasses in the north and of mid and short grasses with tall grasses on the lower slopes in the south. The major species are: western wheatgrass, needle and thread, and blue grama. Soils of the transition prairie support vegetation of mid grasses and some tall grasses in the north and of mid and tall grasses in the south. The major species are: western wheatgrass, little bluestem (*Schizachyrium scoparium*), and needle and thread. Soils of the tall grass prairie support vegetation of tall grasses in the north and south. The major species are: big bluestem (*Andropogon gerardi*), switchgrass (*Panicum virgatum*) and porcupine grass (*Hesperostipa spartea*) (Manske 2008d). Within each of the four prairie types there are differences in plant community structure resulting from variations in the physical, chemical and/or biological characteristics of the soils.

The fertile soils of the tall grass and transition prairies are good for the production of agronomic crops, and much of these native grasslands have been ploughed. Agricultural practice with regard to intact (non-ploughed) grasslands in the Northern Plains has traditionally involved the removal of a portion of above-ground herbage as forage for domesticated livestock. The degree of annual use and level of deterioration are inversely related to the level of managerial land stewardship ethics, and degradation of grassland primarily results from a failure to incorporate into management systems the concept of grasslands as fully functioning ecosystems.

2 Grass plant responses to defoliation

The key factor in meeting grass plant biological requirements is the correct timing of partial defoliation. The effects of defoliation are not simply the removal of herbage from grass plants: foliage removal disrupts plant growth and photosynthesis, and defoliation also affects physiological mechanisms in all parts of the plant (Langer 1956, 1963, 1972). It alters the plant community microclimate by changing light transmission, moisture relations and

temperature (Briske and Richards 1994, 1995), and it changes the soil environment, thereby affecting soil organism activity and ecosystem biogeochemical processes (Manske 2000a, 2011b). Internal plant mechanisms help grass tillers to withstand and recover from partial defoliation by grazing. The primary internal mechanisms are: compensatory physiological mechanisms (McNaughton 1979, 1983; Briske 1991); vegetative reproduction by tillering (Mueller and Richards 1986; Richards et al. 1988; Murphy and Briske 1992; Briske and Richards 1994, 1995); and nutrient resource uptake (Crider 1955; Li and Wilson 1998; Kochy and Wilson 2000; Peltzer and Kochy 2001). In addition, the level of available soil mineral nitrogen has a strong effect on grasses' response to defoliation by influencing compensatory physiological mechanisms and the functionality of vegetative reproduction. These factors are discussed in the following sections.

2.1 Compensatory physiological mechanisms

Compensatory physiological mechanisms give grass plants the capability to replace lost leaf and shoot biomass following grazing by increasing meristematic tissue activity and photosynthetic capacity, and by altering the allocation of carbon and nitrogen. Fully activated mechanisms can produce replacement foliage at 140% of the weight removed during grazing (Manske 2000b, 2010a,b, 2014a,b). The growth rates of replacement leaves and shoots increase after partial defoliation by grazing, and enhanced activity of the meristematic tissue produces larger leaves with greater mass (Langer 1972; Briske and Richards 1995). Developing leaf primordia not fully expanded at the time of defoliation show increased growth rates and tend to grow larger than leaves on undefoliated tillers (Langer 1972). Partially defoliated tillers increase the photosynthetic rates of the remaining mature leaves and rejuvenated portions of older leaves which are not completely senescent (Atkinson 1986; Briske and Richards 1995). Changes in cytokinin levels and other signals produced as a result of the increase in the root–shoot ratio may rejuvenate the photosynthetic apparatus, inhibit or reduce the rate of senescence and increase the lifespan and leaf mass of the remaining mature leaves (Briske and Richards 1995). The activation of compensatory physiological mechanisms after grass tillers are partially defoliated by grazing requires alternative sources of abundant carbon and nitrogen (Coyne et al. 1995). To achieve this the carbon fixed during current photosynthesis in the remaining mature leaf and shoot tissues, and in the rejuvenated portions of older leaves, is preferentially allocated to areas of active meristematic tissue (Ryle and Powell 1975; Richards and Caldwell 1985; Briske and Richards 1995; Coyne et al. 1995). The leaf area required to fix adequate quantities of carbon is 67–75% of the pre-defoliated leaf area (Manske 1999, 2011b, 2014c). Very little, if any, of the carbon and nitrogen stored in the root system is remobilised to support compensatory growth (Briske and Richards 1995). Pools of mobilisable nitrogen in the shoot tissue are reduced following partial defoliation, and this increases preferential use of mineral nitrogen available in the media around the roots (Millard et al. 1990, Ourry et al. 1990). This available soil mineral nitrogen is converted from soil organic nitrogen by active rhizosphere organisms, absorbed through the roots and moved to areas of active meristematic tissue.

2.2 Vegetative reproduction by tillering

Vegetative secondary tillers are shoots which develop on lead tillers from the growth of axillary buds by the process of tillering (Hyder 1974; Dahl and Hyder 1977; Dahl 1995).

Meristematic activity in axillary buds and the subsequent development of vegetative tillers are regulated by auxin, a growth-inhibiting hormone produced in the apical meristem and young developing leaves (Briske and Richards 1995). Tiller growth from axillary buds is inhibited indirectly by auxin interference with the metabolic function of cytokinin, a growth hormone (Briske and Richards 1995). Partial defoliation of young leaf material during the vegetative growth stages temporarily reduces the production of auxin (Briske and Richards 1994). The abrupt reduction of this hormone in the lead tiller allows for cytokinin synthesis or utilisation in multiple axillary buds, thus stimulating the development of vegetative secondary tillers (Murphy and Briske 1992; Briske and Richards 1994). If no defoliation occurs before anthesis, the lead tiller will continue to hormonally inhibit the development of the secondary tiller from axillary buds. The production of auxin declines gradationally as the lead tiller reaches the flower stage. The natural reduction of auxin in the lead tiller usually permits only one secondary tiller to develop. This developing secondary tiller produces auxin which suppresses the development of additional axillary buds (Briske and Richards 1995). Vegetative tiller growth is the dominant form of reproduction in semi-arid and mesic grasslands, not sexual reproduction and the development of seedlings (Belsky 1992; Chapman and Peat 1992; Briske and Richards 1995; Chapman 1996; Manske 1999). Recruitment of new grass plants developed from seedlings is negligible in healthy grassland ecosystems. The frequency of true seedlings is extremely low in functioning grasslands, and their establishment occurs only during years of favourable moisture and temperature conditions (Wilson and Briske 1979; Briske and Richards 1995), in areas of reduced competition from vegetative tillers, and when resources are readily available to the growing seedling.

2.3 Nutrient resource uptake

The dominance of grass plants within a grassland community is related to their competitiveness in terms of nutrient and water resource uptake, but this can be compromised by poor management. For example, Crider (1955) found that grass tillers with 50% or more of the above-ground leaf material removed experienced reduced root growth, root respiration and root nutrient absorption, resulting in reduced functionality of these plants. Reduction of the active root biomass has been found to cause a diminution of grass plant health and vigour (Whitman 1974), leading to a loss of resource uptake efficiency and suppression of the competitiveness of grass plants in taking up mineral nitrogen, essential elements and soil water (Li and Wilson 1998; Kochy 1999; Kochy and Wilson 2000; Peltzer and Kochy 2001). The loss of active root length thus contributes to a reduction in rhizosphere biomass and a decline in ecosystem biogeochemical processes (Coleman et al. 1983; Klein et al. 1988). The nutrient resource uptake competitiveness of healthy grasses is able to suppress the expansion of shrubs and prevent successful establishment of grass, forb and shrub seedlings in grasslands (Peltzer and Kochy 2001). The grass growth form has competitive advantages for nutrient uptake over the shrub growth form (Kochy and Wilson 2000). The above-ground biomass of grasses consists primarily of productive photosynthetic leaves, resulting in high resource uptake efficiency. Grasses are good competitors for below-ground nutrient resources and are superior competitors for mineral nitrogen due to a high root-to-shoot ratio and the absence of woody stems to be maintained. The resource uptake efficiency of shrubs is greatly reduced because a large portion of the photosynthates is used to build and maintain their unproductive woody stems. However, taller woody stems make shrubs superior competitors for above-ground

sunlight resources (Kochy and Wilson 2000). Competition from healthy grasses for below-ground nutrient resources reduces the growth rates of shrub rhizomes and causes high mortality rates among young suckers (Li and Wilson 1998). Shrubs are able to compete for some of the below-ground resources only where the functionality of grass plants has been degraded by ineffective management. Following such reduction, the below-ground resources no longer consumed by the smaller, less vigorous degraded grasses are taken up by shrub plants, resulting in proportional increases in shrub biomass production (Kochy and Wilson 2000). With greater access to nutrient resources, shrub rhizome suckers are able to establish a faster growth rate and a higher survival rate (Li and Wilson 1998). The resulting greater shrub stem density increases competition for light, causing marked suppression of grasses (Kochy and Wilson 2000). Traditionally, the observation of increasing presence of woody shrubs and trees in degraded grasslands would have been attributed to fire suppression (Humphrey 1962; Stoddart, Smith and Box 1975; Wright and Bailey 1982).

2.4 Threshold level of soil mineral nitrogen

Total herbage biomass production in grassland ecosystems has been shown to increase when the quantity of available soil mineral nitrogen increases (Rogler and Lorenz 1957; Whitman 1957, 1963, 1976; Smika et al. 1965; Goetz 1969, 1975; Power and Alessi 1971; Lorenz and Rogler 1972; Taylor 1976; Wight and Black 1979). Grasslands in the Northern Plains which are managed with traditional grazing practices are notorious for their inhibitory deficiency in available soil mineral nitrogen (Goetz et al. 1978), and this leads to their observed low herbage production. In temperate grasslands, deficiencies of mineral nitrogen are more often a cause of limited herbage production than lack of water (Tilman 1990). However, greater quantities of available soil mineral nitrogen have been shown to improve soil water use efficiency in grassland plants (Smika et al. 1965; Wight and Black 1972; Whitman 1976, 1978). Using a proxy method, Wight and Black (1972) found that precipitation (water) use efficiency of grass plants improved when soil mineral nitrogen was available at threshold quantities of 112 kg/ha. The inhibitory effect of deficiencies of mineral nitrogen on grasslands caused herbage production per centimetre of received precipitation to decrease by almost 50% relative to that in grasslands above the threshold (Wight and Black, 1979). Manske (2010a,b) found that this threshold quantity of available mineral nitrogen was also critical for the functionality of vegetative reproduction and for compensatory physiological mechanisms in response to defoliation. Both these mechanisms function at high potential levels in grasslands having 112 kg/ha or greater available soil mineral nitrogen, and do not function (or function at extremely low levels) in those which have mineral nitrogen deficiencies (Manske 2009c, 2010a,b,c, 2011c,d).

3 Agronomic practices to increase soil nitrogen levels

Traditional grazing management practices are known to be antagonistic to rates of mineralisation of soil organic nitrogen, resulting in levels of available mineral nitrogen lower than the threshold quantity of 112 kg/ha (Wight and Black 1972). Previous research in the North American Northern Plains, aimed at developing strategies to increase the quantity of mineral nitrogen in grassland soils, did not incorporate grazing treatments, and instead concentrated on agronomic practices such as nitrogen fertilisation and

inter-seeding alfalfa. The application of nitrogen fertiliser to grasslands did not solve the complex problems related to the causes of low soil mineral nitrogen (Manske 2014d). It was found that nitrogen fertilisation of native grasslands caused a synchronisation of grass tiller growth stage development, resulting in a small increase in herbage biomass which later produced a high rate of leaf senescence and an early season decrease in forage nutritional quality compared to non-fertilised grasslands (Manske 2014d). It also caused a short-term shift in plant species composition, with an increase in mid cool season grasses (e.g. western wheatgrass) and a decrease in short warm season grasses (e.g. blue grama) (Manske 2014d). Initially, these changes were considered to be beneficial (Manske 2009d). However, close examination of the data showed that the costs of the additional herbage weight were excessive (Manske 2009b), and that the long-term disruptions of ecosystem biogeochemical processes were detrimental to desirable plant composition (Manske 2010c). The reduction of short warm season grasses caused a decrease in total live plant basal cover, thus exposing greater amounts of soil to higher levels of solar radiation and erosion (Goetz et al. 1978). These large areas of open space became ideal invasion sites for undesirable plants, resulting in a long-term plant species compositional shift towards a replacement community of domesticated and introduced mid cool season grasses, and in the removal of nearly all the native plant species (Manske 2009a, 2010c). Neither did the strategy of inter-seeding alfalfa into intact semi-arid grasslands solve the complex problems related to the causes of low soil mineral nitrogen (Manske 2005). The introduction of alfalfa increased demand on the existing low levels of soil mineral nitrogen because almost all of the alfalfa plants' nitrogen requirements had to be taken from the soil. The inter-seeded alfalfa plants had extremely low levels of nodulation of rhizobium bacteria on the roots and, consequently, almost no nitrogen fixation. The inoculated rhizobium had been consumed by the resident soil microbes before the alfalfa seedlings had grown sufficient root material to permit infection (Manske 2004b). The low amounts of mineral nitrogen available in the soil resulted in slower rates of growth and higher rates of mortality for the inter-seeded alfalfa plants than those for alfalfa plants solid-seeded into cropland (Manske 2005). In addition, the high water use of the inter-seeded alfalfa plants depleted soil water levels within a 1.5-m radius of each crown to an average of 35% below ambient soil water levels, causing drought stress conditions in the adjacent grass plants and, subsequently, further reducing grass herbage production (Manske 2004a, 2005). In summary, these agronomic strategies slowly stifled grass internal mechanisms and ecosystem biogeochemical processes to ineffectiveness. Grassland ecosystems should, therefore, be managed in accordance with sound ecological principles. These will be described in subsequent sections.

4 Effects of rhizosphere organisms on biogeochemical processes

The rhizosphere (Fig. 1) is the narrow zone of soil around the active roots of perennial grassland plants. In sustainable grassland systems the biogeochemical processes performed by rhizosphere microorganisms renew nutrient flow activities in the soil. Biogeochemical processes transform stored essential elements from organic forms into plant-usable inorganic forms. These processes capture replacement quantities of lost or removed major essential

Figure 1 Rhizosphere on western wheatgrass root.

elements of carbon, hydrogen, nitrogen and oxygen, with assistance from active live plants, and transform them into storage as organic forms for later use. They decompose complex unusable organic material into compounds and then into reusable essential elements (McNaughton 1979, 1983; Coleman et al. 1983; Ingham et al. 1985; Mueller and Richards 1986; Richards et al. 1988; Briske 1991; Murphy and Briske 1992; Briske and Richards 1994, 1995). The quantity of biogeochemical processes taking place in grassland ecosystems is dependent on the rhizosphere volume and microorganism biomass (Coleman et al. 1983). Both these factors are limited by access to simple carbohydrate energy (Curl and Truelove 1986). Healthy grass plants produce double the quantity of leaf biomass (Crider 1955; Coyne et al. 1995), capture and fix large amounts of carbon during photosynthesis, and produce carbohydrates in quantities greater than the amount required for normal growth and maintenance (Coyne et al. 1995). Partial defoliation of grass tillers at the vegetative phenological growth stages by large grazing graminivores causes significant quantities of exudates containing simple carbohydrates to be released from the grass tillers through the roots into the rhizosphere (Hamilton and Frank 2001). As a consequence the biomass and activity of microorganisms also increase (Anderson et al. 1981; Curl and Truelove 1986; Whipps 1990), resulting in greater biogeochemical cycling of essential elements (Coleman et al. 1983; Biondini et al. 1988; Klein et al. 1988; Burrows and Pfleger 2002; Rillig et al. 2002; Bird et al. 2002; Driver et al. 2005).

5 Grazing graminivores

Graminivores which graze grasslands obtain energy, protein, and macro- and micro-minerals from the forage they consume. Perennial grass leaf material consists of digestible nutrients and non-digestible structural components. The available nutritional quality of

the pre-grazed lead tillers of native cool and warm season grasses is closely related to the phenological stages of growth and development, which are triggered primarily by day length (Roberts 1939; Dahl 1995). In the northern hemisphere daylight hours increase during the growing season between mid-April and 21 June and then decrease. All native cool and warm season grasses provide adequate levels of energy to grazing graminivores throughout the growing season. However, providing adequate quantities of crude protein to grazing graminivores during the entire growing season is not as simple and requires detailed knowledge of grass tiller growth stage development and of the resulting changes in their nutritional quality curves in order to properly manipulate the grass lead tillers at specific vegetative growth stages. The crude protein concentration of grass forage available to grazing graminivores on grasslands in the North American Northern Plains is above 9.6% in the lead tillers of the cool and warm season grasses during mid-May to late July. Upland sedges have crude protein levels above 9.6% during early May to mid-July. The secondary tillers of cool and warm season grasses have crude protein levels above 9.6% during mid-July through to late September or mid-October (Whitman et al. 1951; Goetz 1963; Sedivec 1999; Manske 2000c, 2008a,c).

Grazing graminivores should be able to select a diet with adequate crude protein and energy during early June through to mid-October from the available properly manipulated forage plants. The type of animal has a strong effect on the efficiency of nutrient extraction from grazed herbage. Thus, about 15% of the nutrients contained in the consumed leaf material is extracted by stocker heifers and steers and retained for growth. About 30% of the nutrients is extracted by lactating cows, with a portion retained by the cow for production, and the remainder of the extracted nutrients passed on to her calf for growth (Russelle 1992; Gibson 2009). All the non-digestible dry matter and most of the nutrients consumed by grazing livestock are deposited on the ground as manure within a couple of days. Most of the nutrients consumed and used by livestock for maintenance are thus returned to the ecosystem in the faeces and urine. None of the herbage biomass dry matter produced during a growing season is removed by livestock from the grassland ecosystem: all the essential elements contained in the below-ground biomass and the non-consumed above-ground biomass remain in the ecosystem. Thus, almost all the essential elements used in the annual production of herbage biomass and soil organism biomass are retained and recycled in the ecosystem. However, some essential elements are lost or removed from the ecosystem as output. The metabolic process of respiration in soil organisms, plants and animals results in a loss of some essential elements as carbon dioxide, water vapour and heat energy. Some essential elements are removed from the ecosystem as weight biomass produced by insects and wildlife. The essential elements transferred from grass plants to grazing animals and used for growth are removed from the ecosystem (Gibson 2009). However, properly managed annually grazed grasslands activate the internal grass physiological mechanisms and the ecosystem biogeochemical processes which enable the capture of essential elements at quantities equal to or greater than the amount lost or removed.

6 Management of grazing

Intact grasslands can function at their full biological potential by recycling adequate quantities of essential elements through the activity of soil microbes, and by replacing lost

leaf and stem biomass of grass plants through distinctive mechanisms, all of which must be activated by partial defoliation by grazing graminivores.

6.1 'Twice-over rotation' grazing

A biologically effective 'twice-over rotation' strategy has been developed which coordinates partial defoliation events with the grasses' phenological growth stages, meets the nutritional requirements of the grazing graminivores, the biological requirements of the grass plants and the rhizosphere organisms, enhances the ecosystem biogeochemical processes and activates the internal grass plant mechanisms to function at a good-as-new condition (Manske 2016). The 'twice-over rotation' grazing management strategy uses three-to-six native grassland pastures. Each pasture is grazed for two periods per growing season. The number of grazing periods is determined by the number of sets of tillers: one set of lead tillers and one set of vegetative secondary tillers per growing season. Every pasture is grazed for 7–17 days (never less or more) during the first period. This consists of the 45-day interval from 1 June to 15 July, when partial defoliation (25–33%) of grass lead tillers between the 3.5 new leaf stage and the flower stage can increase the rhizosphere organism biomass, enhance the ecosystem's biogeochemical processes and activate internal grass plant mechanisms (Manske 1994a), as described earlier. Manipulation of these processes and mechanisms does not occur at any other time during a growing season (Manske 1999). The number of days of the first grazing period on each pasture is the same percentage of 45 days as the percentage of the total season's grazeable forage contributed by each pasture to the complete system. The forage is measured as animal unit months (AUMs). The number of days grazed is not counted by calendar dates but by the number of 24-h periods grazed from the date and time the livestock are turned out to pasture. During the second grazing period, the 90-day interval from mid-July to mid-October when lead tillers are maturing and defoliation by grazing is only moderately beneficial, each pasture is grazed for twice the number of days as in the first period. Adequate forage nutritional quality during the second period depends on the activation of sufficient quantities of vegetative tillers during the first period. Livestock are removed from intact grassland pastures in mid-October, towards the end of the perennial grass growing season, in order to allow the carry-over tillers to store the carbohydrates and nutrients which will maintain plant mechanisms over the winter. Most of the upright vegetative tillers on grassland ecosystems during the autumn are carry-over tillers which will resume growth as lead tillers during the next growing season. Almost all grass tillers live for two growing seasons, the first season as vegetative secondary tillers and the second as lead tillers. Grazing carry-over tillers after mid-October cause the termination of a large proportion of the population, resulting in greatly reduced herbage biomass production in subsequent growing seasons (Manske 2011b). The pasture grazed first in the rotation sequence is the last pasture grazed during the previous year. The last pasture grazed had the greatest live herbage weight on 1 June of the following growing season (Manske 1999, 2011b).

7 Degradation of grasslands

Degradation of grasslands occurs from three primary causes: when management of graminivore grazing fails to adequately activate the ecosystem's biogeochemical processes

and the internal grass plant mechanisms, when partial defoliation by grazing graminivores is removed from the grassland and when greater than 50% of the grass herbage biomass is consumed by heavy or late-season grazing, or fire (Manske 2012b).

7.1 Seventy-five years of non-grazing

Ownership of much of the public domain land in the North American Northern Plains was transferred from the U.S. Government through the Homestead Act of 1862 and the Federal Railroad Land Grant Act of 1864. These laws were adjusted several times, but the lawmakers failed to address the requirements of the natural resources in semi-arid regions, causing numerous long-lasting management problems. In addition, the economic depression of 1929, the severe drought conditions of 1934 and 1936, and low agricultural commodity prices during the late 1920s and early 1930s created extreme hardships for these homesteaders. Starting in 1935, the U.S. Government was permitted to repurchase more than 405 thousand hectares of submarginal homestead land in North Dakota (Hibbard 1965; Carstensen 1968; Manske 1994b, 2008b). A 1937 law provided for the implementation of follow-up conservation and utilisation programmes and the development of improved practices of management of the repurchased grasslands. The Agriculture Resettlement Administration of U.S. Department of Agriculture (USDA) authorised the establishment of experimental range-land management laboratory areas by North Dakota Agricultural Experiment Station on the Little Missouri River Badlands (Whitman 1953). In 1936, Dr. Warren C. Whitman established four two-way range-land reference areas. These included a livestock exclosure and a similar area exposed to livestock grazing on sandy, shallow, silty and overflow ecological sites (Hanson and Whitman 1938). This ongoing long-term project monitors changes in herbage biomass production, plant species composition and soil characteristics inside the non-grazed exclosure areas and in the grazed areas. During the growing season of 2011, the effects of long-term non-grazing after 75 years were compared to the effects of moderately stocked, season-long grazing treatments, that is, 7–8 months from 1 May to 31 December, with the grazing season shortened because of inclement weather conditions during most years.

Changes in vegetation composition over time were described using the 'range condition index'. Range condition index is the per cent similarity of the per cent composition of the dry weights of major plant species and categories of minor species on a current ecological site compared to the hypothetically determined standards of the per cent composition of the dry weights of the major and minor species for that same plant community at its best biological potential. Above-ground herbage biomass was collected by the standard clipping method (Cook and Stubbendieck 1986) sorted in the field into domesticated grasses, cool season grasses, warm season grasses, sedges, forbs, standing dead, litter and oven dried. Plant species' basal cover was determined by the ten-pin point frame method (Cook and Stubbendieck 1986) and sorted into domesticated grasses, cool season grasses, warm season grasses, sedges, forbs and litter. The density of forbs was determined by counting individual stems of each forb species rooted inside twenty-five 0.1 m^2 quadrats. The density of shrubs was measured by counting the individual plants of each shrub species rooted inside twenty-five 1.0 m^2 quadrats. A list of the shrubs, cacti and trees present was also compiled. These procedures adequately represented the shrub component of the grazed plant communities. However, because of the great extent and quantity of woody species growing inside the exclosures, these methods greatly under-sampled the woody plants within each exclosure. The surface areas of the woody

shrub and tree map units and the non-woody grass map units were measured in area as digital data in ArcGIS by visual assessment of USDA National Agriculture Imagery Program 2009 orthoimages as displayed by Google Earth. This was conducted by the Dickinson State University, Department of Agriculture and Technical Studies. Below-ground plant root biomass was collected on the non-grazed and grazed treatments of each ecological site by two replicated soil cores 7.6 cm in diameter and 10.2 cm in depth. Rhizosphere biomass was collected by three replicated soil cores, using a humane soil beastie catcher (Manske and Urban 2012a). The fresh rhizosphere material, which included the rhizosphere organisms, the active plant roots and the adhered soil particles, was separated from matrix soil by meticulous excavation with fine hand tools. Soil mineral nitrogen, nitrate and ammonium were also measured in both treatments.

The traditional season-long management practice, that is, grazed at moderate stocking rates from early May until inclement weather or to late December, was found to be severely antagonistic to silty ecological sites of mixed grass prairie grasslands. After 75 years, the plant communities had been degraded to a range condition index of 53.6 (low good). The above-ground vegetation consisted of 6.3% standing dead and 93.7% live biomass. The peak growing season live herbage biomass was 1875.82 kg/ha, comprising 41.4% domesticated grasses, 30.3% native cool season grasses, 12.0% native warm season grasses, 8.9% upland sedges and 7.5% forbs (Table 1). The basal cover consisted of 64.3% litter and 30.1% live herbage. The live basal cover was 58.1% domesticated grasses, 10.8% native cool season grasses, 9.2% native warm season grasses, 19.0% upland sedges and 3.0% forbs (Table 2). The total forb density was 10.5 stems/0.1 m^2, comprising 48.9% late succession, 30.5% mid-succession and 20.6% early succession forbs. The 'woody species present' list identified two shrub species on the grazed area. The below-ground root biomass was 24.8 kg/m^3 and the rhizosphere biomass was 138.6 kg/m^3 (just 34.1% of its potential weight, 406.4 kg/m^3) (Manske 2015) and the available mineral nitrogen was deficient at 14.3 mg/kg (Manske 2013) (Tables 3 and 4).

The long-term non-defoliation management practice of complete rest from grazing for several decades was also extremely antagonistic to mixed grass prairie grasslands. After 75 years of non-defoliation, the plant communities had been degraded to a range condition index of 19.1 (poor). The above-ground vegetation comprised 21.6% standing dead and 78.4% live biomass. The peak growing season live herbage biomass

Table 1 Herbage biomass (kg/ha) on nongrazed compared to grazed treatment on the silty ecological site after 75 years 1936–2011

	Grazed	Nongrazed	%Difference
Domesticated	776.06	1599.26	106.07
Cool season	567.46	113.49	−80.00
Warm season	225.39	0.80	−99.65
Upland sedge	167.04	127.08	−23.92
Forbs	139.87	167.84	20.00
Total live	1875.82	2008.47	7.07
Standing dead	125.48	553.86	341.39
Litter	630.59	2421.68	284.03

Table 2 Basal cover (%) on nongrazed compared to grazed treatment on the silty ecological site after 75 years, 1936–2011

	Grazed	Nongrazed	% Difference
Domesticated	17.45	11.65	−33.24
Cool season	3.25	0.00	−100.00
Warm season	2.75	0.00	−100.00
Upland sedge	5.70	1.15	−79.82
Forbs	0.90	2.40	166.67
Total live	30.05	15.20	−49.42
Litter	64.25	84.80	31.98

Table 3 Root and rhizosphere biomass (kg/m^3) on nongrazed compared to grazed treatment on the silty ecological site after 75 years, 1936–2011

Biomass	Grazed	Nongrazed	%Difference
Root	24.82	16.73	−32.59
Rhizosphere	138.63	132.08	−4.72

Table 4 Soil available mineral nitrogen, nitrate and ammonium, (mg/kg) on nongrazed compared to grazed treatment on the silty ecological site after 75 years, 1936–2011

Mineral nitrogen	Grazed	Nongrazed	% Difference
Nitrate, NO_3	3.37	3.07	−8.90
Ammonium, NH_4	10.92	9.81	−10.16
$NO_3 + NH_4$	14.29	12.88	−9.87

was 2008.47 kg/ha, made up of 79.6% domesticated grasses, 5.7% native cool season grasses, 0.04% native warm season grasses, 6.3% upland sedges and 8.4% forbs (Table 1). The basal cover consisted of 84.8% litter and 15.2% live herbage. The live basal cover was 76.6% domesticated grasses, 0.0% cool and warm season grasses, 7.6% upland sedges and 15.8% forbs (Table 2). The total forb density was 12.8 stems/0.1 m^2, with 98.1% late succession, 1.9% mid-succession and 0.0% early succession forbs. The problem of shading eliminated early succession forbs. The 'woody species present' list identified nine shrubs, one cactus and two trees on the non-grazed area. The area infested with woody shrubs and trees was 53.8% of the non-grazed exclosure (Fig. 2, Table 5). The below-ground root biomass was 16.7 kg/m^3, the rhizosphere biomass was 132.1 kg/m^3 (only 32.5% of its potential weight) (Manske 2015) and the available mineral nitrogen was deficient at 12.9 mg/kg (Manske 2013) (Tables 3 and 4).

It can be concluded that 75 years of non-grazing caused greater degradation to the site than traditional season-long management practice. The range condition index of the plant community on the non-grazed area degraded 64.4% more than that on the grazed area. On the non-grazed area, the herbage biomass of native cool season grasses, warm

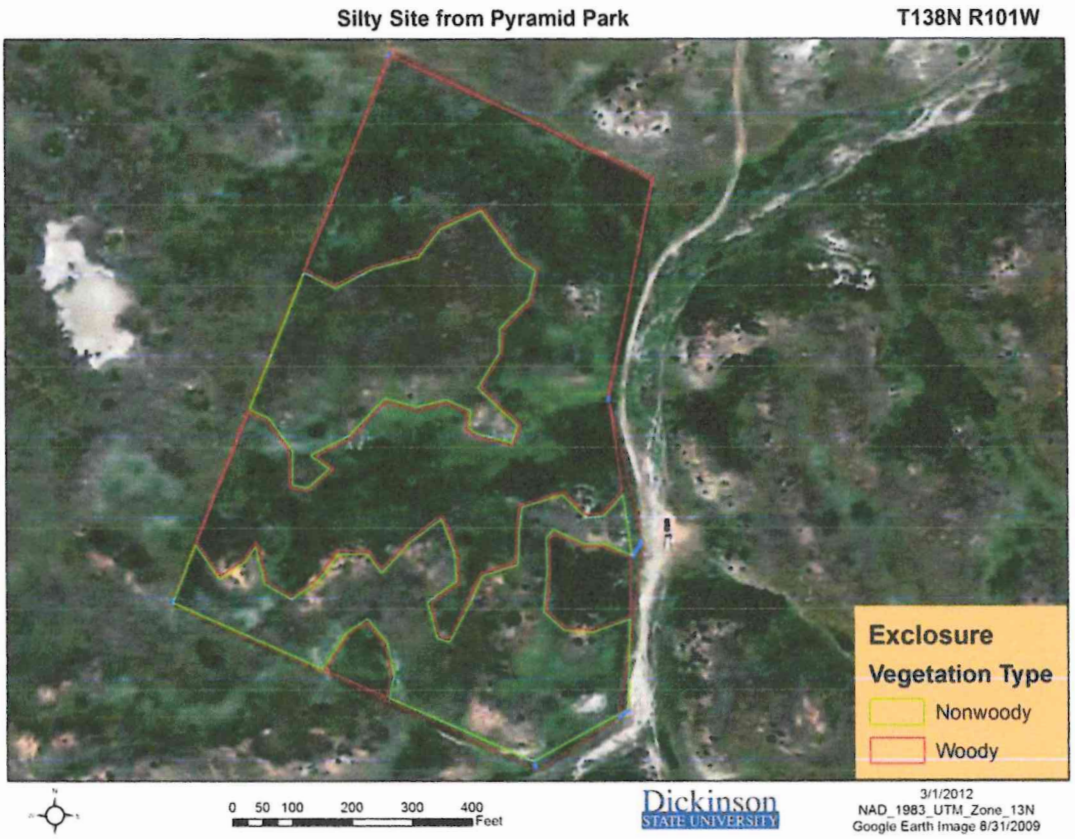

Figure 2 Silty ecological site exclosure with woody shrub and tree infested plant communities and non-woody grass plant communities in the Little Missouri River Badlands, 1936–2011.

Table 5 Woody infested shrub and tree plant communities and non-woody grass plant communities on the silty ecological site after 75 years, 1936–2011

	Total exclosure area	Non-woody grass	Woody infested shrub and tree
Hectares	5.71	2.64	3.07
Percentage		46.23	53.77

season grasses and upland sedges decreased by 80.0%, 99.7% and 23.9%, respectively, and basal cover decreased 100.0%, 100.0% and 79.8%, respectively (Tables 1 and 2). The basal cover of native grasses with long shoots and stem leaves was 1.1% on the grazed area and 0.0% on the non-grazed area (a 100.0% decrease). The basal cover of native grasses with short shoots and basal leaves was 10.7% on the grazed area and 1.2% on the non-grazed area, an 89.2% decrease in the non-grazed area. Grasses with short shoots and basal leaves protect the soil and restrict invasion of unwanted plants. Thus, the higher losses of grasses with short shoots and basal leaves provided open spaces for a greater increase of domesticated grasses in the non-grazed area. The herbage biomass of domesticated grasses increased by 106.1%, and basal cover decreased by 33.2% in the non-grazed area (Tables 1 and 2). The domesticated grass basal cover was high in both grazed and non-grazed areas of the site. On the grazed area, it was 49.6%

Figure 3 Silty ecological site, exclosure with increased woody vegetation.

greater than that on the non-grazed area. However, the domesticated grass herbage biomass in the grazed area was 51.5% less than that in the non-grazed area, indicating that the domesticated grass tillers in the grazed area were numerous but small compared to the large and robust domesticated grass tillers on the non-grazed area. The herbage biomass of forbs increased by 20.0%, basal cover increased by 166.7%, forb stem density increased by 22.1%, and the number of forb species present decreased by 56.3% in the non-grazed area (Tables 1 and 2). The number of woody shrub and tree species present increased 500.0%. Analysis of black and white aerial photographs estimated shrub cover at 5% during the mid-1930s (Smith 1988). After 75 years, the area covered by the woody plant infestation in the non-grazed exclosure had increased by 976% (Fig. 3). Standing dead herbage biomass increased by 341.4% and litter increased by 284.0% in the non-grazed area (Table 1). The total dead biomass on the non-grazed area was 48.2% greater than the total live biomass. The below-ground root biomass decreased by 32.6% in the non-grazed area and coincided with the 49.4% decrease in total live plant basal cover. The rhizosphere biomass decreased greatly in both the grazed and non-grazed areas but decreased 4.7% more in the non-grazed area (Table 3). The decrease in rhizosphere microbe biomass preceded the decrease in native grass plant composition, which was followed by the increase in domesticated grass composition. Available mineral nitrogen decreased by 9.9% more on the non-grazed area (Manske 2013) (Table 4).

In conclusion, non-defoliation management by completely resting mixed grass prairie grasslands is not a revitalising strategy. Removing graminivores from grasslands to provide rest from grazing results in decreased rhizosphere organism biomass, which in turn leads to deficiencies in mineral nitrogen and other essential elements, degradation of grassland ecosystems and the encroachment of woody shrubs, trees and domesticated grasses. From these results it is clear that grazing graminivores form an essential annual component of grassland management.

7.2 Effects of fire

Many grassland ecologists have accepted the observational concept that fire prevents the intrusion of shrubs and trees into grasslands (Weaver 1954; Humphrey 1962; Daubenmire 1974; Stoddart, Smith and Box 1975; Wright and Bailey 1982). However, the presence of fire does not prove that grasslands need or are caused by fire (Heady 1975). The existence of a shrub component in a grassland is not an ecologically beneficial relationship as shrubs and grasses are adversarial inhibitive competitors. They compete for sunlight, mineral nitrogen, other essential elements and soil water. Fire in grasslands cannot prevent the invasion of, or cause the removal of, shrubs and trees that are able to reproduce by vegetative secondary suckers (Wright and Bailey 1982; Manske 2006a,b). Almost all deciduous woody plants reproduce vegetatively, except big sagebrush (*Artemisia tridentata*) (Manske 2014e). Seedlings of trees, shrubs, weedy forbs and introduced grasses cannot become established in grasslands containing grasses with full nutrient resource uptake competitiveness (Peltzer and Kochy 2001). Intrusive seedlings can only be established after a grassland has been degraded by poor management practices. Repeated prescribed fire can modify the composition of the above-ground vegetation in degraded grasslands which have been invaded by shrubs. The composition of introduced cool season grasses may change, and early succession and weedy forbs, and shrub aerial stems decrease temporarily after four repeated prescribed fires (Manske 2007a, 2011a). However, the fundamental problems of weak nutrient resource uptake, reduced water use efficiency, non-functional compensatory physiological mechanisms, impaired vegetative reproduction by tillering and diminished biogeochemical processes will remain in the degraded grassland ecosystem following repeated fire events. None of the biological, physiological or asexual mechanisms within grass plants and none of the rhizosphere microbes or biogeochemical processes they perform are activated by fire (Manske 2007a, 2011a). Almost all of the essential elements in the above-ground herbage are volatilised when a grassland is burned, and if the soil is dry, some of the below-ground essential elements are also lost (Russelle 1992). When the losses of essential elements are greater than the quantity of captured essential elements, the result is degradation of the grassland (McGill and Cole 1981). Fire does not improve grassland ecosystems biologically or ecologically and it cannot replace the partial defoliation achieved by grazing graminivores in managing healthy and productive grassland ecosystems.

8 Initial changes of restoration

A working cattle ranch, prior to 1993, was used as a study area of degraded mixed prairie grasslands. It comprised 805 ha and was managed under traditional season-long practices based on use as forage for livestock grazed at moderate-to-heavy rates, maintaining low-production native grassland ecosystems. Management based on use for recreation and wildlife habitat changed with ownership, and cattle grazing was removed for 13 years between 1993 and 2005. This resulted in severely degraded plant communities dominated by undesirable cool season domesticated grasses, primarily Kentucky bluegrass (*Poa pratensis*), smooth bromegrass (*Bromus inermis*) and crested wheatgrass (*Agropyron cristatum*). A 6-year restoration project was conducted from 2006 to 2011. It described and evaluated the development of the initial changes brought about by biological restoration in degraded intact grassland ecosystems through implementation of

the previously described three-pasture 'twice-over rotation' management strategy when compared to a non-grazed control (Manske 2012c). Above-ground herbage biomass, basal cover, rhizosphere biomass, and soil mineral nitrogen, nitrate and ammonium, were measured as described earlier.

Vegetation in the control pasture changed slightly during the six years of non-grazed management. Domesticated grass herbage biomass increased by 38.5% and basal cover increased by 45.5%. Cool season grass herbage biomass increased by 61.1% and basal cover decreased by 70.8%. Warm season grass herbage increased inconsequentially by 21422.5% and basal cover increased by 1600.0%. The warm season grass on the non-grazed pasture was a small remnant colony of prairie sandreed (*Calamovilfa longifolia*) that had developed a few stems above the height of the Kentucky bluegrass mats and was able to only increase herbage biomass to 172 kg/ha and basal cover to 0.85% during six growing seasons. Upland sedge herbage biomass increased by 65.5% and basal cover decreased by 63.2%. Forb herbage biomass increased by 340.5% and basal cover increased by 300.0%. Total live herbage biomass increased by 54.9% and total live basal cover increased by 21.1%. Standing dead herbage biomass decreased by 32.6%, litter biomass increased by 14.1% and litter basal cover decreased by 3.6% (Tables 6 and 7).

The composition of vegetation in the grazed pastures improved during the six years of management. Although the native grasses increased greatly, the domesticated grasses had not yet been adequately suppressed, and therefore the grassland ecosystem cannot

Table 6 Changes in herbage biomass (kg/ha) on the nongrazed control pasture, 2006–2011

	Pretreatment	Year 3	% Difference	Year 6	% Difference
Domesticated	1886.99	1478.58	−21.64	2614.06	38.53
Cool season	39.96	108.98	172.72	64.39	61.14
Warm season	0.80	50.58	6222.50	172.18	21422.50
Upland sedge	8.00	22.72	184.00	13.24	65.50
Forbs	47.15	30.26	−35.82	207.68	340.47
Total live	1982.90	1691.12	−14.71	3071.55	54.90
Standing dead	2043.64	1040.14	−49.10	1376.50	−32.64
Litter	3120.20	2824.48	−9.48	3560.23	14.10

Table 7 Changes in basal cover (%) on the nongrazed control pasture, 2006–2011

	Pretreatment	Year 3	% Difference	Year 6	% Difference
Domesticated	10.55	11.20	6.16	15.35	45.50
Cool season	1.20	3.55	195.83	0.35	−70.83
Warm season	0.05	0.40	700.00	0.85	1600.00
Upland sedge	2.85	1.90	−33.33	1.05	−63.16
Forbs	0.05	0.10	100.00	0.20	300.00
Total live	14.70	17.15	16.67	17.80	21.09
Litter	85.20	82.85	−2.76	82.15	−3.58

be said to have fully recovered. Domesticated grass herbage biomass increased by 18.3% and basal cover increased by 99.4%. Cool season grass herbage biomass increased by 1090.5% and basal cover increased by 112.4%. Warm season grass herbage biomass increased by 388.9% and basal cover increased by 488.4%. Upland sedge herbage biomass decreased by 35.0% and basal cover increased by 25.2%. Forb herbage biomass decreased by 32.2% and forb basal cover decreased by 13.8%. Total live herbage biomass increased by 32.1% and total live basal cover increased by 67.8%. Standing dead herbage decreased by 58.0%, litter biomass decreased by 45.9% and litter basal cover decreased by 10.8% (Tables 8 and 9). At the end of the 6-year study, the comparators between the grazed and non-grazed control pastures respectively were as follows: domesticated grass herbage biomass was 46.0% less and basal cover was 55.2% less. Cool and warm season native grass herbage biomass was 168.5% greater and basal cover was 438.3% greater. Upland sedge herbage biomass was 1974.2% greater and basal cover was 809.5% greater. Forb herbage biomass was 46.0% less and forb basal cover was 150.0% greater.

An important finding of this study was the difference in response of rhizosphere weights to the different treatments. Changes in these weights in the non-grazed pasture were small and appeared to be related to changes in growing season precipitation. During years 1 to 5, the growing season precipitation changed little, and was 76.6% of the long-term mean (LTM). The mean rhizosphere weight in the non-grazed pasture remained constant over the first five years, and was 76.5 kg/m^3 (18.8% of potential weight, 406.4 kg/m^3). During

Table 8 Changes in herbage biomass (kg/ha) on the grazed twice-over pasture, 2006–2011

	Pretreatment	Year 3	% Difference	Year 6	% Difference
Domesticated	1194.46	348.06	−70.86	1412.59	18.26
Cool season	48.75	211.62	334.09	580.36	1090.48
Warm season	11.20	25.52	127.86	54.76	388.93
Upland sedge	422.40	299.03	−29.21	274.59	−34.99
Forbs	165.45	39.39	−76.19	112.12	−32.23
Total live	1842.26	923.62	−49.86	2434.42	32.14
Standing dead	1359.50	470.81	−65.37	570.94	−58.00
Litter	1860.61	1248.58	−32.89	1005.95	−45.93

Table 9 Changes in basal cover (%) on the grazed twice-over pasture, 2006–2011

	Pretreatment	Year 3	% Difference	Year 6	% Difference
Domesticated	3.45	4.08	18.26	6.88	99.42
Cool season	1.85	4.08	120.54	3.93	112.43
Warm season	0.43	2.73	534.88	2.53	488.37
Upland sedge	7.63	10.75	40.89	9.55	25.16
Forbs	0.58	0.40	−31.03	0.50	−13.79
Total live	13.94	22.04	58.11	23.39	67.79
Litter	85.90	78.18	−8.99	76.63	−10.79

year 6, there was a substantial increase in growing season precipitation, and consequently the rhizosphere weight in the non-grazed pasture increased to 130.6 kg/m^3. Nevertheless, this was still substantially less than the potential rhizosphere weight (Table 10, Fig. 4). Rhizosphere weights in the grazed pastures were not significantly different from those in the non-grazed pasture during years 1 and 2. They increased by 33% during the third year on the grazed pastures and continued to increase at a mean rate of 30.5 kg/m^3 per year

Table 10 Rhizosphere weight (kg/m^3) for the nongrazed control pasture and grazed twice-over pastures, 2006–2011

	Nongrazed pasture	Grazed pastures	% Difference
Pretreatment	52.23	77.99	49.32
Year 1	64.24	83.28	29.64
Year 2	77.82	92.22	18.50
Year 3	70.67	122.61	73.50
Year 4	82.88	140.32	69.31
Year 5	86.85	183.00	110.71
Year 6	130.56	214.34	64.17

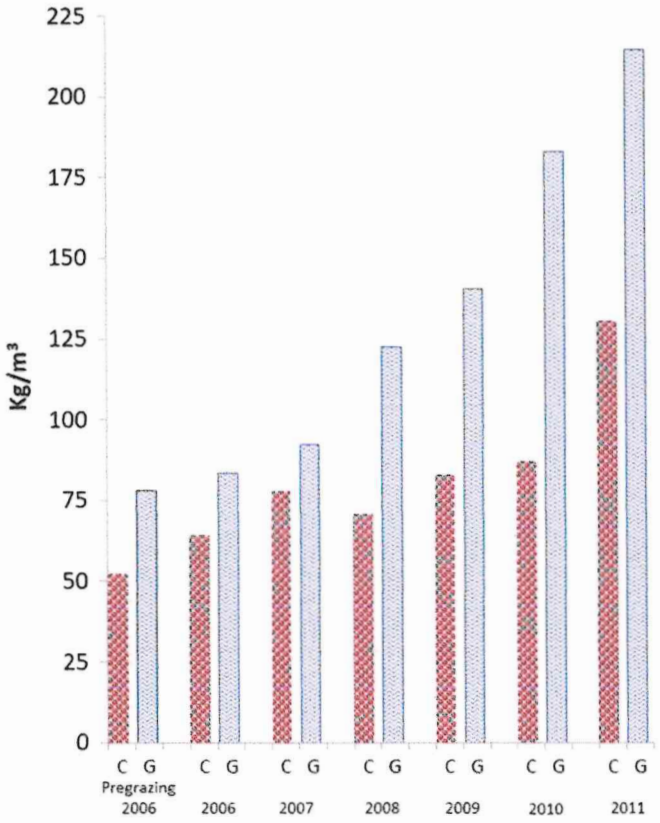

Figure 4 Rhizosphere weight kg/m^3 for the control pasture (red spheres) and grazed pastures (blue waves) during six years of twice-over rotation management, 2006–2011.

from year 3 to 6, reaching a weight of 214.3 kg/m^3 (52.7% of the potential rhizosphere weight) (Manske 2015) (Table 10, Fig. 4).

The quantity of mineral nitrogen available in a soil is the net difference between the total quantity of organic nitrogen mineralised by soil microorganisms and the quantity of mineral nitrogen immobilised by plants and soil microbes (Brady 1974; Legg 1975). The quantity of available mineral nitrogen varies cyclically with changes in soil temperature, soil microbe biomass, and plant phenological growth and development during the growing season (Whitman 1975). The relationships between soil microbe activity and the phenology of plant growth activity result in a dynamic cycle of available mineral nitrogen (Goetz 1975). When mineralisation activity by soil microbes is greater than plant growth activity, the quantity of available mineral nitrogen increases. When transformation (immobilisation) of mineral nitrogen by plant and soil microbe growth activity is greater than mineralisation activity, the quantity of available mineral nitrogen decreases. In this experiment, during the spring available mineral nitrate and ammonium were 64.6% and 20.5% greater in the grazed than the non-grazed treatments, respectively. Levels of total available mineral nitrogen were 111.3 kg/ha (99.4% of the threshold quantity) and 79.8 kg/ha (71.2% of the threshold quantity), that is 39.5% greater under grazing (Table 11). The rhizosphere weight was 214.3 kg/m^3 vs. 130.6 kg/m^3, that is 64.2% greater under grazing (Table 10). The quantity of available mineral nitrogen is also related to the rhizosphere weight. The rhizosphere microbe biomass and activity are in turn affected by the quantity of exuded short carbon compounds. The quantity of exuded carbon in the non-grazed pasture is restricted to plant leakage, while on the grazed pastures it is greater than the quantity of leakage. This is because partial defoliation by graminivores when grass tillers are at the vegetative growth stage causes greater quantities of simple

Table 11 Spring available nitrate (NO_3) and ammonium (NH_4) at incremental depths in kg/ha on silty ecological sites of the nongrazed control and grazed twice-over pastures

Soil depth (cm)	Nongrazed spring available	Twice-over spring available	% Difference
NO_3 nitrate			
0–15.2	14.84	33.19	123.65
15.2–30.5	10.92	12.75	16.76
30.5–61.0	8.61	10.64	23.58
0–61.0	34.37	56.56	64.56
NH_4 ammonium			
0–15.2	22.39	22.64	1.12
15.2–30.5	13.80	15.90	15.22
30.5–61.0	9.23	16.18	75.30
0–61.0	45.42	54.71	20.45
NO_3 + NH_4			
0–15.2	37.23	55.81	49.91
15.2–30.5	24.72	28.64	15.86
30.5–61.0	17.84	26.82	50.34
0–61.0	79.79	111.27	39.45

carbon compounds to be exuded from the grass tillers into the rhizosphere (Anderson et al. 1981; Curl and Truelove 1986; Whipps 1990; Hamilton and Frank 2001; Manske 2011b). The grazing treatment removed around 25% of the leaf material of the native grasses when the tillers were between the 3.5 new leaf stage and the flower stage. This progressively decreased the rates of leaf senescence and increased photosynthetic rates, thus increasing both the quantities of fixed carbon available for increasing plant growth and the exudation of simple carbon compounds released through the plant roots into the rhizosphere. During year 3, the rhizosphere weight in the grazed pastures increased to 73.5% greater than that in the non-grazed pasture. This in turn increased the mineralisation of greater quantities of nitrogen and other essential elements from soil organic matter, resulting in greater activity of compensatory physiological mechanisms and vegetative reproduction by tillering. The end result was an increase in herbage biomass production and basal cover of the cool and warm season grasses through year 6. Thus, restoration of degraded grasslands slowly builds the ecosystem's biogeochemical processes, and the internal grass mechanisms slowly change the plant species composition. The 3-year lag period between the start of the grazing treatment and a substantial response in rhizosphere weight, and the slow increase in above-ground herbage biomass and basal cover of the native cool and warm season grasses is important. This indicates that brief research projects which are functional for too short a time are likely to produce erroneous conclusions, for example the short-term research data reported by Sheley and Svejcar (2009) and Ranellucci et al. (2012). Traditional management practices have neglected the vital cryptobiotic microorganism component. These microorganisms are critical for the renewability of grassland natural resources. Microbes cycle essential elements from unusable organic forms into usable mineral forms. Reductions in microorganism quantity or activity therefore translate into a reduction of usable essential elements. A diminution of available essential elements is the cause of degradation in grassland productivity (Bloem et al. 2006). The quantity of essential elements used and lost from the ecosystem must be replenished at equal or greater quantities annually.

9 Future trends and conclusion

Microorganisms recycle the essential elements required for life on earth. Much of the basic science of microbe biology and processes are already known (Bloem et al. 2006). However, little of this scientific knowledge has been incorporated into the management of the world's renewable natural resources of intact grasslands, seeded grasslands, croplands, forestlands and fisheries. Productivity of these renewable resources has been declining for decades because of the reduction in the quantities of recycled essential elements (Bloem et al. 2006). Strategies are required that will enhance the capacity of microorganisms to recycle greater quantities of essential elements within the ecosystems of the renewable resources if productivity is to reach the level of future demands.

10 Where to look for further information

The key to elevating productivity on renewable natural resources, that is, intact grasslands, seeded grasslands, croplands and forestlands, is to increase the quantity of plant-available essential elements, primarily nitrogen. Mineralising greater quantities of essential elements

from soil organic matter requires a great amount of soil microbes. The increase of soil microbe biomass and activity depends on annual exudation of short carbon chain energy at quantities greater than that from plant leakage. This book chapter has shown how to increase mineralisation of essential elements with rhizosphere organisms by increasing grass exudates with partial defoliation by grazing graminivores coordinated with grass plant phenological growth stages. Additional information on this subject is available at http://www.grazinghandbook.com. Increasing short carbon chain energy exudates to soil microbes at greater quantities than plant leakage for the purpose of increasing available essential elements on renewable natural resources that typically do not include grazing graminivores in their standard management strategies is a major scientific challenge that will need to be solved through research in order to improve productivity that can meet future demands.

The established organisations that promote the study of grassland management are yet to make the connection between above-ground management activity and the below-ground response and the connection between the resulting below-ground activity and the above-ground plant response, primarily because of the multiple-year lag time intervals involved. The author is not aware of any organisations that actively support grazing management of grasslands in order to meet the biological requirements of grass plants and to enhance the biomass and activity of soil microbes for the purpose of improving ecosystem functionality and productivity.

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